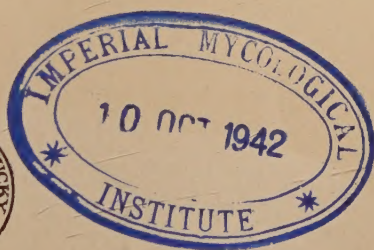


Agricultural Experiment Station

of the

UNIVERSITY OF KENTUCKY

FIFTY-FOURTH ANNUAL REPORT



Report of the Director
for the year 1941

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LETTER OF TRANSMITTAL

To His Excellency, Hon. Keen Johnson, Governor of Kentucky:

Sir: In accordance with an act of Congress, approved March 2, 1887, entitled, "An act to establish Agricultural Experiment Stations, in connection with the Agricultural Colleges established in the several states under the provisions of an act approved July 2, 1862, and under the acts supplementary thereto," and of the act of the Legislature of the State of Kentucky, approved February 20, 1888, entitled, "An act to accept the provisions of an act passed by the Congress of the United States, approved March 2, 1887, for the establishment and maintenance of Agricultural Experiment Stations in connection with Agricultural Colleges established by the several states and territories under the act of Congress approved July 2, 1862," I herewith submit the fifty-fourth annual report of the Kentucky Agricultural Experiment Station.

Very respectfully,

THOMAS P. COOPER, Director.

ANNUAL REPORT
of the
DIRECTOR OF THE KENTUCKY
AGRICULTURAL EXPERIMENT STATION
For the Year 1941

There seems to be no end to the fundamental problems and questions on agricultural matters that require careful and often prolonged research before they can be answered. It is the purpose of the Kentucky Agricultural Experiment Station to conduct its investigations in the fields of primary interest to Kentucky farmers, tho frequently the results of its investigations are applicable to problems in many states, and sometimes they are even international in bearing.

War has greatly increased the demands upon agriculture. More food, and more of the raw materials of industry that come from the farm are required for our own needs; and the demand for these products is multiplied by the necessity of providing them also for our allies. To meet this program of agricultural production, farmers will need to make the best possible use of their land, labor, capital, and ability. They will find it necessary, as never before, to use the most effective methods of culture, management, and protection of plants and animals from disease, pests of various kinds, and other controllable losses. It is here, precisely, that the accomplishments of the Kentucky Agricultural Experiment Station, and of similar institutions in other states, stand the country in good stead, for the experience of capable scientists over many years has built up an immense body of knowledge on efficient production of farm crops and animal products.

New lines of research are being undertaken by the Experiment Station as a direct contribution to war needs. For example, because of the extensive study made here on the paratyphoid group of bacteria, the Station was requested to undertake, as a definite part of the war effort of the country, the preparation of diagnostic sera for identifying and classifying typhoid and paratyphoid infections among service men and civilians in defense areas. Again, a project was organized continuing the study of farm labor, its sources, places of recruitment, and possible training in farm skills. Another type of research has furnished information enabling Kentucky farmers to undertake intelligently the production of castor beans for war uses.

Varieties were checked and their productivity and growth determined on sample plots in various sections of the state, and a small threshing machine was devised by the agricultural engineering staff to thresh the beans. Still another type of research, involving a study of farm and land resources in the mountains of Kentucky should give information which will be helpful in the post-war period.

Many other examples of research relating to war and defense activities might be cited. However, those special wartime projects are not, after all, the main contribution of the Experiment Station to the war effort. Successful wartime agricultural production continues to depend upon the maintenance of soils and their fertility, the use of superior varieties of crops, the proper feeding of livestock for maximum products at minimum costs. In a word, a wartime agriculture requires the best in agricultural research.

SOILS AND CROPS

Effect of cropping and manure treatments on amount of nitrogen in soil.— In experiments with 3-year rotations of corn or tobacco, wheat, and a hay crop on Maury silt loam at the Station farm, the nitrogen content of the soil was determined at the end of the first, the ninth, and the eighteenth year. In certain rotations, where no manure is applied, red clover is compared with soybeans as the hay crop, corn and wheat being the other crops in the rotations. In the 18-year period the soil in the red-clover plots gained 490 pounds of nitrogen per acre and that in the soybean plots lost 440 pounds per acre, as an average of duplicate plots. Where manure was applied on 4 other plots, at the rate of 8 tons per acre per rotation, the average increase in nitrogen in 18 years was 450 pounds, as compared with the average of 6 plots not manured but treated the same otherwise.

Trend of soil nitrogen content in the two 9-year periods differed considerably. In most treatments the trend was upward in the first period and downward in the second. As an average of all treatments (28 plots), soil nitrogen increased 280 pounds per acre in the first period and decreased 510 pounds in the second period. The difference probably was the result of differences in rainfall in the two periods. In the main, rainfall was satisfactory for crop growth in the first period, but in the second period several years were very dry and stands and growth of hay crops were unsatisfactory.

Phosphorus compounds in Kentucky soils.— Use of different extracting solutions on the same samples of soil indicates that 2

percent or less of the phosphorus content of ordinary acid, low-phosphate soils of the state are calcium phosphates, between 60 and 70 percent are iron and aluminum phosphate, and 30 to 35 percent is contained in organic matter. About 12 or 15 percent of the iron and aluminum phosphates and 30 percent of the phosphorus in the organic matter is quite readily extractable and also is more or less readily available to plants. Much of the phosphorus in the highly phosphatic bluegrass soils is in the calcium compounds.

Manure as a source of potash.— This year the third crop of corn, the second crop of wheat, and first crop of clover were obtained from plots where manure had been used at the rates of none, 4, 6, and 8 tons per acre in each of six rotation periods from 1920 to 1938. After the discontinuance of manure treatments the plots were divided lengthwise and muriate of potash applied broadcast to half of each plot (check plots included) at the rate of 200 pounds per acre, when the series was planted to corn. The soil is Maury silt loam, containing about 4,700 pounds of phosphorus and 24,000 pounds of potassium in 2,000,000 pounds of surface soil. When the experiment was begun the land was limed.

The increases in yield of corn for these years, from addition of potash, were: no manure, 6.3 bushels per acre; 4 tons of manure per acre, 3.4 bushels; 6 tons of manure per acre, 2.3 bushels; and 8 tons of manure per acre, 1.3 bushels. The increase from potash where 8 tons of manure had been used was small, indicating that the reserves from this amount of manure practically met the need of corn for potash. The average yields on the "no manure" plot were 54.9 bushels per acre with potash and 48.6 bushels without potash. The reserve from 8 tons of manure practically met the needs of the other crops for potash. Wheat apparently is not affected as early by potash deficiency as is corn, for applied potash had very little effect on wheat.

Effect of excessive liming on yield and quality of crops.— Since 1928 experiments have been carried on at the Experiment Station farm at Lexington, to determine the effect upon yield and quality of crop, of heavy liming such as is likely to occur when marl is used. A 4-year rotation of corn, tobacco, wheat, and red clover is followed. Ten tons of stall manure are used for corn, and 500 pounds of fertilizer at the row on the tobacco crop. A 4-8-4 fertilizer was used until recently, when a 6-8-6 analysis was substituted. Despite the use of the manure and fertilizers, yields of tobacco and clover on plots which were limed at the rate of 10 tons per acre or more in

1928-29 are still considerably depressed in some years. In other years the depressing effect is not so great.

In 1941, corn yields on the plots receiving 10, 25, and 50 tons of limestone per acre were 31.2 bushels, 25.7 bushels, and 26.6 bushels per acre, respectively, as compared with an average check-plot yield of 43.7 bushels an acre. Yields of red clover were not greatly depressed in 1941 where liming had been heavy but were depressed over 40 percent in 1940 on such plots. With tobacco, heavy lime applications resulted in a greater reduction in value than in yield, altho yield also was seriously reduced in some years. In 1940, yields where the 10-, 25-, and 50-ton rates were used were only about 6 percent lower than the average of the check plots, but the value of the tobacco on these plots was 45 percent less than on the check plots. In 1939 neither yield nor value was less on the heavily limed plots. Wheat yield was reduced little, if any, by the heaviest lime applications.

It seems clear that very heavy liming such as is likely to occur when marl is used may result in serious crop losses.

Pastures: effect of different fertilizer treatments on phosphorus and calcium content of herbage.—Several experiments on fertilizing pastures were carried on in 1941 in cooperation with the Tennessee Valley Authority. In one of these calcareous slag from the electrical furnaces was tested as a top-dressing. On an average, an initial treatment of 1,250 pounds of this slag increased the calcium content of the herbage about the same as treatments with an equal weight of limestone. The phosphorus content of the herbage from the slag-and-superphosphate treated plots was about 10 percent higher than that in the herbage from the plots receiving superphosphate alone. Superphosphate applied alone at the rate of 150 pounds of 20-percent grade per acre per year increased the phosphorus content of the herbage about 14 percent.

Herbage from another pasture top-dressing experiment was enriched in phosphorus by applications of 32 pounds per acre of phosphoric acid biennially in different phosphates. The herbage from the untreated plot of one field contained 0.11 percent of phosphorus; that from another field contained 0.21 percent; and that from a third contained 0.12 percent. The average phosphorus percentages of the herbage from the treated plots were 0.15, 0.28, and 0.14, respectively.

In a third test, on two soil types, the effect on pasture herbage of incorporating phosphate fertilizers in the soil at the time of seeding the pastures was compared with top-dressing after the pasture was

seeded and established. Yields obtained were 7 percent in one test and 14 percent in the other in favor of incorporating the fertilizer in the soil prior to seeding.

Tests for need of the minor elements in soils.—Field tests of some of the minor elements required by crops were made in 1940 and 1941 on M, MLP, and MLPK treatments of the outlying experiment fields. A mixture of the sulfates of copper, magnesium, manganese, zinc, cobalt, potassium iodide, and borax was used in amounts considered not to be harmful to the crops. Applications were made on a small portion of each plot as follows: *For wheat*, top-dressing in early spring at the rate of 215 pounds per acre; *for corn*, at the hill, when planted, 54 pounds per acre; *for tobacco*, in the row, 70 pounds per acre.

Also, the several minerals were used separately on alternate rows of the "no treatment" corn plots in 1941 at Berea, Campbellsville, and Greenville. No significant effects on any of the crops grown, from any of the treatments with minor elements, were evident.

Effect of manure on yield and quality of burley tobacco.—The value of animal manure in producing high yield and good quality in burley tobacco was shown in the tobacco experiments conducted at the Greenville Soil Experiment Field in 1940. A plot of land which in previous years was the phosphate-limestone plot in a series, but which had received no application for several years, was divided into two equal parts. One part received manure at the rate of 15 tons an acre, and 20-percent superphosphate at the rate of 500 pounds an acre. The yield from this half of the plot was 1,413 pounds an acre, valued at $21\frac{2}{3}$ cents per pound, or \$306 an acre. The other part of the plot was fertilized at the rate of about 1,000 pounds per acre of an 8-10-10 fertilizer. The yield, 1,450 pounds an acre, was slightly higher than that of the plot receiving manure. It was valued at only $17\frac{1}{4}$ cents a pound however, and the acre-value was therefore only \$250, as compared with \$306 for the plot treated with manure and superphosphate. An adjacent unmanured plot which received only limestone and phosphate produced at the rate of 1,115 pounds of tobacco per acre, valued at $14\frac{2}{3}$ cents per pound, making the acre value \$163.

Fertilizer tests with tobacco on soil experiment fields.—Fertilizer experiments with tobacco are being made at the Campbellsville, Greenville, and Mayfield experiment fields, the tobacco being grown in a 6-year rotation of wheat one year, legumes and bluegrass sod three years, and tobacco two years. Wheat and hay crops

responded to use of limestone, phosphate fertilizers, and manure about as they did in the corn rotation. The use of potash and nitrogen in addition to the phosphate produced larger increases and better quality in tobacco. At Greenville, where manure is not used, nitrogen and potash have been especially effective, the value per acre in 1940 being about 50 percent greater than when potash and nitrogen were not used in the fertilizer. Manure is used at Campbellsville and Mayfield at the uniform rate of 6 tons per acre for each tobacco crop. The results for 1940 are given in the following table since those of the current year are not yet available.

TABLE 1.—YIELD AND VALUE OF TOBACCO GROWN ON FERTILIZER EXPERIMENT PLOTS AT CAMPBELLVILLE, GREENVILLE, AND MAYFIELD, 1940

	Yield per acre				Value per acre			
	O	LP	LPKN	PKN	O	LP	LPKN	PKN
	lb.	lb.	lb.	lb.				
Campbellsville (burley)	1033	1302	1600	1454	\$118	\$176	\$235	\$220
Greenville (burley)	606	1114	1317	1184	42	163	245	216
Mayfield (dark fired)	1440	1590	1762	1570	75	76	98	97

O=no fertilizer, L=limestone, P=250 pounds 20 percent superphosphate, K=100 pounds sulfate of potash, N=200 pounds nitrate of soda.

Fertility vs. moisture in the growth of burley tobacco.—Farmers attributed the poor growth and marked firing of the bottom leaves of the 1941 burley crop, one of the poorest in years, to the drouth during the last half of July and August. According to soil tests in 134 tobacco fields in central Kentucky, made in connection with a field study of bacterial leaf spot diseases, much of the poor growth and firing was due not so much to the drouth as to lack of available plant nutrients. In 26 fields where available potassium and phosphorus were high, tobacco grew satisfactorily with a minimum of firing. But in 108 fields where potassium, and sometimes phosphorus, was low, tobacco was stunted and badly fired at the bottom. Typical potash starvation symptoms were observed in 58 of these fields of burley tobacco in the central Bluegrass area. Tests of the soils from these fields showed that available potassium was low to very low.

Row-spacing of burley tobacco.—During the past few years an increasing number of growers in the more level and productive areas of the district have been spacing burley tobacco rows 36 inches apart, instead of the customary 42 inches. These growers believe they obtain better yield and quality from this closer spacing of rows. Since spacing of the plants in the 36-inch rows is the same as in the 42-inch rows, the number of plants grown per acre is increased about

16 percent. Obviously, to transplant, top, sucker, and strip this additional number of plants increases labor cost per acre considerably. To determine whether the closer spacing of rows is an advantage, the Kentucky Station began tests in 1938 comparing yield and quality of tobacco grown in the closer-spaced rows and in the rows with customary 42-inch spacing.

Federal graders were unable to note any difference in quality in any of the three years for which results now are available, and the relative weights of the different grades did not differ consistently. Total yields differed, however, as shown in the following table:

Year	Acre-yield		Acre-value*	
	36-in. spacing (lb.)	42-in. spacing (lb.)	36-in. spacing	42-in. spacing
1938	1519.3	1762.7	\$374.50	\$441.58
1939	1689.4	1710.7	324.35	325.98
1940	1410.4	1273.5	241.53	214.32
Average	1539.7	1582.3	313.46	327.29

* Based on average price for season on markets that had federal grading.

Evidently the season determines relative yield from the different row spacings. In 1938 heavy rainfall during July and August caused a rank growth and premature yellowing of the leaves. The cured tobacco was very thin because the crop had to be harvested before the leaves thickened. In 1939 there was just sufficient rain to permit normal maturity. In 1940 rainfall was scanty and tobacco spread little, but leaf body was heavy. In the most "normal" season (1939) yields and values differed very little. Average yields and values for the three years also differed little. From the data now available it would seem safe to conclude that there is not sufficient gain from the closer spacing of rows to pay for the extra costs of production.

Vitamin B₁ in setting tobacco plants.— In tests on the Station farm in 1941 vitamin B₁ used in setting tobacco plants failed to bring about any significant improvement in the vigor of the plants. Three different rates of application were compared with the control, in which the tobacco setter was filled with water only instead of B₁ solution. Tests were replicated four times early in the setting season, and again late in the setting season. At one time the soil moisture was high and the other time low.

Priming the lower leaves of burley tobacco.— On certain rows of the 1940 crop of burley tobacco at the Station farm, about 3 lower leaves per plant were primed on August 22, and the tobacco was cut September 19. The tobacco handled in this way returned \$42.27 more per acre than that handled in the usual way, as an average of five replications. Since the time required by inexperienced

labor for priming the leaves and placing them on sticks was about 65 man-hours per acre, the returns for priming amounted to about 66 cents an hour. A similar experiment in 1939 gave a return of 42 cents an hour.

Tobacco curing experiments.— In experiments with the 1940 and 1941 crops of burley tobacco in automatically controlled curing chambers, little if any damage resulted from maintaining a relative humidity of 75 percent or slightly below 65 percent. For the 1938 and 1939 crops the optimum was 65 to 70 percent. This difference in results between different crops is too small to be of practical importance because relative humidity in tobacco-curing barns as now built and operated, cannot be controlled to so close a limit. This point is mentioned because it is believed by some that the optimum temperature and humidity for curing tobacco is affected to a considerable degree by the conditions under which the crop is grown. Little evidence of such a difference has been found, however, in these tests.

In earlier tests it was shown that the quality of tobacco cured with temperature and relative humidity held constant is similar to that cured where these conditions fluctuated daily, as they would in the curing barn, provided the average temperature and humidity are the same in both cases. These results were confirmed in 1941.

If tobacco is cured at too high a relative humidity, it not only loses a great deal in quality but it also loses somewhat in weight. This loss of weight amounts to about 10 percent if the tobacco is cured at a relative humidity high enough to produce incipient houseburn.

A search for new uses for low-grade tobacco.— Most of the work so far (the project was started in July, 1940) has dealt with testing the effectiveness of different solvents for extracting some of the constituents in tobacco. The solvents used were ethyl ether, petroleum ether, skellysolve "B", acetone, ethyl alcohol, methyl alcohol, benzene, and carbon tetrachloride. For extracting nicotine, the best solvent was methyl alcohol. Methyl alcohol also dissolved more of the ash than any other solvent. For fats, resins, and waxes, the best for commercial use were skellysolve "B" and carbon tetrachloride; and for removing the extracts used in making varnish and stains, the best were petroleum ether and carbon tetrachloride.

From the ether-soluble or fatty portion of the extract soap was made. The unsaponifiable portion of the extract (about 30 percent of the total) was separated into two fractions by precipitating from the ether solution by the addition of alcohol. The precipitate ob-

tained was a white waxy substance, and the residue remaining after the solution was evaporated had a dark brown color, but was more liquid than the residue before the separation was made. These two fractions would appear to have commercial possibilities in the resin and wax industries.

Two varnish stains prepared from extracts obtained with petroleum ether and carbon tetrachloride produced on dressed wood a lustrous water-proof stain and finish without the application of any other water-proofing or finishing material. Nicotine was extracted completely and recovered from the extract. Such nicotine can of course be used for making the pure alkaloid or making insecticide dusts, sprays, dips, or nicotine bentonite.

Finally, after all the soluble constituents are removed from tobacco, there remains a large amount of crude cellulose which can be used for making such products as fiber board, carton board, wrapping paper, packing and insulating materials. Fiber board made in the laboratory was dense, tough, hard, and could be sawed, cut, and polished the same as boards of wood. Because the fiber board can be molded and cut into any desired shape and form, it would seem to offer many possibilities of use.

Root-rot-resistant white burley, Ky. 16. — Ky. 16 burley tobacco, a variety developed at this Station, has now been certified by the Kentucky Seed Improvement Association for four years, and the certified seed is being sold by more than thirty growers in Kentucky and several Tennessee growers are raising and selling certified seed. The variety appears to be well established. Judging from the sale of certified seed, more than 60 percent of the burley crop in Kentucky and neighboring states is Ky. 16. This variety not only outyields the other commonly grown varieties in fields infected with black root rot, but on uninfected land has returned 10 to 30 percent more per acre than the commonly grown stand-up varieties of burley.

Fusarium-wilt-resistant white burley, Ky. 33. — Tobacco growers along the Ohio River and in a few other parts of Kentucky where fusarium wilt is injurious are gradually turning to the use of Ky. 33 burley, a variety developed at this Station resistant to this fusarium wilt. Seed was raised and sold by one commercial grower in 1941. The tobacco is fast growing and early maturing. The quality has proved satisfactory. Ky. 33 is not recommended for general planting, however, where fusarium wilt is not prevalent.

Mosaic-resistant burley tobacco. — A strain of burley tobacco (Ky. 48-7) homozygous for the N factor obtained from *Nicotiana*

glutinosa has proved to be practically immune to tobacco mosaic. The plant has much the appearance of Ky. 16 but is smaller and yields less. In comparative tests Ky. 48-7 produced only 77 percent as much per acre as Ky. 16. It is used by county agents and others to demonstrate that mosaic can be controlled by breeding, and in comparison with other varieties to demonstrate that mosaic is easily spread by handling susceptible plants.

Many of the hybrids of Ambalema (mosaic resistant) with Ky. 16 burley even after several back crosses, have proved undesirable because of too low yield and a character, apparently derived from Ambalema, which results in leaf scald during hot weather. After rapid growth the upper leaves often wilt and fail to recover completely, leaving large scalded areas on the leaves. Further back-crossing with Ky. 16 may, however, eliminate undesirable characters.

A burley hybrid containing the types of resistance to mosaic derived from both *N. glutinosa* and Ambalema develops necrotic spots at points of inoculation much more slowly than mosaic-resistant strains (*glutinosa* type) lacking the Ambalema type of resistance, and because of this fact seedling plants appear to be nearly completely protected against the systemic streak disease which usually follows inoculation of small plants with the tobacco mosaic virus if inoculated leaves are not soon removed. Inasmuch as necrotic spots develop very slowly in the field, these plants may be considered nearly completely immune to mosaic.

Mosaic-resistant dark tobacco.— Because of the great losses from mosaic in dark tobacco, an attempt is being made to produce mosaic-resistant strains of several of the dark tobacco varieties grown in western Kentucky, as rapidly as possible, by introducing the N factor from *Nicotiana glutinosa*. The fifth back crosses with several dark varieties were made this year. In the heterozygous condition (for N) the hybrid strains appear nearly identical with the original dark tobacco varieties.

Progress is also being made in the development of mosaic-resistant dark varieties of the Ambalema type, which are resistant to black root rot also. Further back crosses with the desirable dark type will be necessary before satisfactory resistant varieties can be developed.

The *Plantago major* virus.— An outbreak of a virus disease of burley tobacco near Lexington in 1941 was determined to be caused by a virus common in *Plantago* sp. first reported by this Station in 1930. About 2 percent of the plants were greatly stunted, somewhat necrotic, and with somewhat the appearance of plants affected with streak virus. On the varieties Kelley and Pepper the *Plantago* virus

causes local necrotic lesions sometimes followed by systemic necrosis and chlorosis, while on Turkish and Ky. 16 burley it causes systemic mottle mosaic with a somewhat different pattern from that caused by the ordinary strains of tobacco-mosaic virus.

Legume viruses transmissible to tobacco.—A virus disease of alfalfa characterized by irregular yellow to (occasionally) almost white areas on a few leaflets per plant was transmitted mechanically to tobacco plants. Chlorotic, sometimes necrotic, ring-and-line patterns developed on the rubbed tobacco leaves, followed by the development of yellow to almost white ring patterns in new leaves, which usually were reduced in size and badly distorted. The disease was mechanically transmitted also to pepper, tomato, and cucumber plants, but mechanical transmission to pokeweed and garden bean gave only local necrotic spots. The virus seems to be a strain of *Marmor medicaginis* H.

A virus disease of white clover, characterized by irregular yellowish patches on otherwise normal leaves, was also transmitted mechanically to tobacco plants. Chlorotic ring and line patterns developed in inoculated leaves and irregular scattered yellowish spots on new leaves. The disease was readily transmitted mechanically to garden pea plants, where it caused mottling and streak, and to garden bean plants, where it caused local necrotic spots and a mosaic-like mottling.

A virus was transferred from a red clover plant, which showed prominent vein yellowing, to tobacco thru dodder. The virus produced symptoms typical of the cucumber-mosaic virus in tobacco, cucumber, tomato, and pokeweed. The clover-disease virus appears to be a strain of the common cucumber mosaic virus.

The virus of tobacco streak was transferred from tobacco to sweet clover thru dodder. In the sweet clover it caused a ring-spot-like mottling similar to a common field disease of sweet clover. The virus was transferred back to tobacco from infected sweet clover by dodder in one trial.

Phosphorus starvation spotting of tobacco.—What is believed to be a leaf spot caused by phosphorus starvation was observed in a few fields of burley tobacco in the central Bluegrass area. Early in the season affected plants were dwarfed, had a chlorotic cast to the leaves, especially at the basal halves, and numerous small, necrotic, circular spots, not unlike those developing in tobacco in pot cultures of low phosphorus content, were present on many of the leaves, often tho not always more numerous at the tips. Chemical tests of both leaves and soil showed that the phosphorus content was very

low. In one field where this condition was pronounced, soil tests indicated that there were fewer than 10 pounds of available phosphorus to the acre when the tests were made. About midseason or later, it was difficult to find affected plants, presumably because the root systems were occupying relatively larger soil volumes.

Sources of bacterial leaf-spot infection. — No satisfactory explanation of the source of plant-bed and field infection with the bacterial leaf-spot organisms of tobacco has yet been made, tho this year, apparently for the first time, it was conclusively proved that *Bacterium angulatum*, one of these organisms, can remain viable in field soil over winter. Between November 2, 1940, and April 18, 1941, *Bacterium angulatum* was recovered from 37 soil samples collected on nine different dates, of a total of 180 samples collected on fifteen different dates. These samples were from fields where naturally infected tobacco was grown in 1940. From 542 samples collected on forty-five different dates from bluegrass and clover fields, *Bacterium angulatum* was isolated from 13 samples collected on two different dates and each was from a field adjacent to a tobacco field. The organism was isolated by pouring a water suspension of soil over the under-surface of a water-soaked leaf. The bacteria could be isolated from the leaf spot.

Soil samples collected from 196 tobacco beds, prior to emergence of the plants and until setting time, were also tested in 1941 for the presence of *Bacterium tabacum* and *Bacterium angulatum* by inoculating tobacco plants in the greenhouse with water suspensions of the soils. *Bacterium angulatum* was obtained from one sample from a bed that was used in 1940. Fifty soil samples, representing 750 places in each of two fields set from bordeaux-treated beds, were collected following light showers in early July. Inoculations from these to burley tobacco were negative. A like number of samples collected from the same fields a week later, following a rain, appeared free of leaf-spot organisms. Two hundred five samples collected at some distance from infected plants resulted in no infection, while 90 samples collected from near infected plants caused infection in 24 instances, indicating that the bacteria had probably washed from infected leaves to the soil.

Thruout the summer a detailed study was made of the development of leaf spot in tobacco plots on the Station farm which had been set with plants visually free from leaf spots. After the first heavy rain, which caused water-soaking of leaves, no spotting could be found, but gradually, following subsequent rains, leaf spot developed

in a few centers. The observations suggested local sources of infection in the field but the nature of the source of infection is unknown.

In connection with studies on infection from soil, it was of interest to know how few bacteria were capable of causing infection. Twenty-four-hour broth cultures of *Bacterium angulatum* were diluted with sterile water and suspensions placed on water-soaked areas of leaves. Infection occurred from 1 100 cc drops of 24-hour broth cultures diluted 1:1,000,000. Similar drops on agar plates produced very few colonies. It was concluded that probably as few as three or four bacteria were capable of causing leaf spots.

Weed control.—During a study of white grub control in bluegrass sod, it was observed that dandelions (*Taraxacum palustre* (Lyons) Lam. and DC. var. *vulgare* (Lam.) Fern.) were injured by an application of β - β -dichloroethyl ether. A series of plots was thereupon established on bluegrass sod that had not been mowed or grazed during recent years, and certain of the plots were treated with a mixture of dichloroethyl ether in water in the proportion of 32cc in 1 gallon. One set of plots was treated with the mixture at the rate of 1 gallon per square yard, another set at the rate of $2\frac{1}{4}$ gallons per square yard. Eleven days after the treatment the roots of 95.1 percent of the dandelion plants treated at the heavier rate were killed to a depth of 4 to 6 inches. The lesser application gave a "kill" of 78.6 percent. "Tergitol" penetrant 7 used in combination with the 1-gallon application did not increase its effectiveness. Nine weeks after the treatments were made, young leaves were emerging from the soil from a few large dandelion roots that had been killed to a depth of 6 inches. Whether similar recovery by plants with smaller roots will occur is not known. The bluegrass was injured in only a very few small areas.

Spiny sida plants (*Sida spinosa* L.) were killed by dichloroethyl ether at the heavier rate of application used. Plants of milk purslane or spotted spurge (*Euphorbia maculata* L.), yellow foxtail (*Setaria lutescens* (Weigel) F. T. Hubb), and three-seeded mercury (*Acalypha virginica* L.) were not injured. Plants of buckhorn (*Plantago lanceolata* L.) and *Paspalum pubescens* Muhl. were injured very slightly in some instances.

Alfalfa-grass combinations.—In yield tests this year, of tall oatgrass, bromegrass, redtop, timothy, and native meadow fescue, each seeded alone and in combination with alfalfa, the average acre-yield of the grasses seeded alone was only 56 percent of the average acre-yield (3,388 pounds per acre) of the alfalfa-grass combinations.

Yield of alfalfa alone was 3,874 pounds dry matter per acre. All yields were of dry matter from 2 first-year cuttings.

Grass mixtures.—In yield tests, begun in 1940, of various grasses in mixture with Kentucky bluegrass, the mixture of Kentucky bluegrass, timothy, and a native variety of meadow fescue yielded the most dry matter per acre in the two years 1940 and 1941. The other combinations tested with Kentucky bluegrass were: redtop and meadow fescue, orchard grass and brome grass, redtop and brome grass, orchard grass, orchard grass and meadow fescue, redtop, timothy and brome grass.

Nurse crops for grass or lespedeza.—In a test this year, ryegrass seeded at 5, 10, and 20 pounds per acre and kept clipped, allowed average stands of other grasses (Kentucky bluegrass, redtop, timothy, and orchard grass) of but 64, 54, and 39 percent, respectively, of the stands had from seeding the grasses alone. In a similar comparison of ryegrass as a nurse crop for korean lespedeza, the stands of lespedeza were 90, 71, and 79 percent of those where lespedeza was seeded alone. Better stands of lespedeza were had in Kentucky bluegrass or in timothy than in orchard grass or redtop. In comparisons of wheat, rye, and barley as nurse crops for grasses all stands were satisfactory where the nurse crops were kept down to about 6 inches tall. Where the small grains were allowed to mature, barley was the best nurse crop, tho the stands of grasses were only 53 percent of those where the grasses were seeded alone. In the unclipped nurse crops orchard grass and Kentucky bluegrass were definitely superior in competitive ability to timothy and redtop, the average stands of the four being 69, 65, 50, and 39 percent, respectively, of those where seeded alone.

Effect of "bluegrass plant bug" on seed setting.—Because this insect (*Miris dolobratus*) frequently is abundant on bluegrass from which poor seed crops are harvested, a study was begun to determine whether this bug might be a cause of the poor seed development. Two cheesecloth-covered cages were placed in a plot of Kentucky bluegrass strain 35 about two weeks prior to anthesis, and the grass was dusted with pyrethrum powder to kill such bluegrass plant bugs as might be present. Later, one of the cages was heavily stocked with the insect. None of the heads under the cage heavily infested with the bug produced seed, but about 37 percent of the seeds or florets in the cage free of bugs were good hard seeds. Outside the cages the grass, rather heavily infested naturally, produced about 34 percent good hard seeds; and about 5.6 percent soft seeds; 13.6

percent shrivelled seeds, and the remainder undeveloped or partly developed seeds.

Bluegrass and legumes vs. bluegrass alone. — Mixtures of Kentucky bluegrass and certain legumes averaged three times as many pounds of dry matter per acre as bluegrass grown alone. Bluegrass and korean lespedeza produced the largest yield, 1,865 pounds of dry matter per acre. Even when fertilizers were used on the bluegrass grown alone, the yield was not this high. Of several fertilizers applied, an application on March 10 of 200 pounds of sodium nitrate, 100 pounds of superphosphate, and 50 pounds of potash produced the largest forage yield. This yield was, however, 300 pounds less per acre than the yield of the bluegrass-lespedeza combination to which no fertilizer was applied.

Effect of soil-nitrogen level on bluegrass seed development. — Applications of 300 and 600 pounds of sodium nitrate and 500 and 1,000 pounds of sugar per acre were used to produce variations in the level of available nitrogen under Kentucky bluegrass about a week before anthesis. No significant differences were brought about in amount of seed with hard endosperm tho some of the earlier stages of floret development were significantly affected in two of the three strains of Kentucky bluegrass studied.

Red-clover improvement. — In the variety and strain tests conducted in cooperation with the U. S. Department of Agriculture there was much less difference than usual between yields of the better adapted southern clovers. Adapted clovers from Kentucky, Tennessee, and Virginia produced between 3,800 and 4,800 pounds (average, 4,100) of dry matter per acre from two cuttings. Oregon clovers produced an average of 2,307 pounds. One Kentucky-grown clover produced 3,272 pounds, and a Minnesota clover produced only 972 pounds.

Ten pounds of red clover seed were harvested from second-year third-generation plants of the southern variety being developed in cooperation with the U. S. Department of Agriculture for resistance to anthracnose. This variety produced 3,932 pounds of dry matter per acre in the variety tests, a yield which compares favorably with the average of yields by other adapted clovers this year. It is twice as resistant to southern anthracnose (*Colletotrichum trifolii* B. and E.) as the other best adapted southern clovers. Next year it will be included in the variety tests at several locations in the southern clover region and grown for seed increase for further tests in the state.

Plants of red clover selected for resistance to powdery mildew

(*Erysiphe polygoni* D. C.) and southern anthracnose (*Colletotrichum trifolii* C. and E.) were cross-pollinated, and from these crosses lines with a high degree of homozygosity for resistance to these diseases are being developed by sib-pollination for use in improving the selected variety and possible use in recombinations for developing other improved varieties.

In the first year of a study of variation in mortality, leaf marking, flowering, stems, forage, and seed yields in spaced plants of seven adapted varieties of red clover, there was a greater difference within the varieties than among them. These results indicate that all these varieties are very heterozygous and offer a wide genetic base for improvement.

Red clover-alfalfa mixtures.—Three mixtures of red clover and alfalfa produced average yields of 200 and 800 pounds more dry matter per acre from two cuttings than separate plantings of alfalfa and red clover, respectively.

Hybrid-corn yields.—Twenty-four hybrids and one local variety were included in the 23 uniform cooperative tests conducted in various parts of Kentucky in 1941. The hybrids comprised the principal yellow and white hybrids of which commercial seed is produced in the state and experimental hybrids from the Kentucky Station. In nearly all parts of Kentucky the weather after late July became progressively drier, which favored the earlier maturing sorts. Since the commercial yellow hybrids are earlier maturing, on the average, than the white, it is not surprising that they outyielded the latter by an average of about 3 bushels per acre, which, however, is not a significant difference.

The striking feature of the test was the large difference in yield between the hybrids and open-pollinated varieties, in each test a popular variety in the section where the test was held. The average yield of the open-pollinated varieties was 45 bushels an acre; that of all the hybrids, 54 bushels, or 20 percent more. Kentucky 103, the highest yielding hybrid in the test, averaged 59 bushels an acre, which is 14 bushels (31 percent) more than the open-pollinated. In only 1 test of the 23 did the open-pollinated variety yield more than the average for all hybrids.

Soybean variety tests.—During the past few years the production of soybean seed for oil has become increasingly important in western Kentucky, particularly as a replacement crop on bottom land. In 1940 and 1941 the Station tested at Lexington a number of the varieties which it seemed might be best adapted to Kentucky.

These were all yellow-seeded sorts, as seed of any other color is not wanted for oil extraction. Averaging the results for two seasons, which were quite unfavorable for soybeans, the highest yield was obtained from a variety from the U. S. Department of Agriculture, U. S. 70218-2 (known popularly as US-2). This variety, according to observations in cooperative experiments in western Kentucky, stands up well and is very resistant to shattering. The next highest yield at Lexington was from Scioto, and the third highest from Ill. T119. U. S. 54563-5, which seems to excell in ability to stand up well and to resist shattering, was not outstanding in yield in the Lexington tests. Macoupin, which is well liked in western Kentucky, was not among the highest yielding varieties. However, differences in yield were probably not great enough to be very significant, considering that the tests have been conducted for only two years (Macoupin, one year only).

Effect of boron on the growth of soybean plants. — In cultures in sand, in soil, and in equal parts of sand and soil, in the greenhouse, the best growth of soybeans occurred with applications of boric acid at the rates of 0.4 to 0.8 part of boron per million parts of the culture. At concentrations of 1 ppm or more, the boron was toxic to the plants.

Tests were also made of soybean plants growing in the field, in soil which contained, by analysis, 28 ppm total and 0.38 ppm water-soluble boron. Applications of boric acid ranged up to 15 pounds per acre. No toxic effect was observed from these applications. The leaves of the soybean plants grown where 15 pounds per acre was applied contained 100 ppm boron, whereas leaves of those grown where none was applied contained 64 ppm boron.

Castor beans. — Yields of adapted varieties of castor beans grown on the Station farm at Lexington ranged from 1,121 to 1,918 pounds of beans per acre. An adapted variety planted in various parts of the state in cooperative tests with farmers produced from 165 to 711 pounds per acre, the yields being low probably because the beans were planted late (about the middle of June) and the weather was very dry thereafter. In cooperative tests with farmers to study effects of fertilizers and rates of planting, the differences in results obtained were not significant, tho slightly more favorable to 4,000 to 8,000 plants per acre than to a smaller number. Efforts to develop an improved variety were continued.

LIVESTOCK

Feeding, Management, Diseases

Rye vs. bluegrass as winter pasture for pregnant ewes.—Twenty crossbred western ewes were divided into two lots of ten each. One lot was allowed to graze from December 12, 1940, to April 24, 1941, on 4.3 acres of rather close-grazed bluegrass; the other was given access to 4.6 acres of good fall-seeded rye. Both lots were housed at night. On frosty mornings they were kept up until the forage thawed, and were fed 2 pounds of U. S. No. 1 alfalfa hay per ewe. When the weather was very unfavorable or ground was covered with ice or snow, the ewes were kept up all day and fed 4 pounds of U. S. No. 1 alfalfa hay per ewe. Water, salt, ground limestone, and steamed bonemeal were available at all times.

The ewes grazed on rye kept in slightly better condition, sheared somewhat heavier fleeces, and gave birth to heavier lambs which gained slightly faster than those grazed on the bluegrass. These results substantiate those obtained in other years when rye made a good fall growth. In years when rye was poor, bluegrass gave the better results.

Alfalfa hay vs. red clover hay for pregnant ewes.—Two lots of 10 bred western ewes each, housed in a barn with outside runway and with access to salt, steamed bonemeal, and ground limestone, were fed alfalfa hay and red-clover hay, respectively, at the rate of 5 pounds per ewe per day. The alfalfa hay graded U. S. No. 1 extra green extra leafy and was some of the best Nebraska hay available. The red clover hay was noticeably coarser and was U. S. No. 2 grade.

Lambs from the ewes fed the alfalfa hay were somewhat larger at birth and at 28 days, and weighed 7.8 pounds more per lamb at 56 days of age than the lambs from the ewes fed red clover. Only 10.3 percent of the alfalfa hay was refused by the ewes as against 16.4 percent of red-clover hay refused. The ewes fed alfalfa hay kept in better condition thruout the test and sheared an average of 1.11 pounds more wool per ewe than those fed the red-clover hay.

Continuous vs. rotational grazing of bluegrass pastures.—For the sixth successive year, a 5.8-acre permanent bluegrass pasture was grazed continuously by one group of dairy heifers, while a similar adjoining pasture divided into 2 equal parts was grazed alternately by an equal number of heifers of about the same age and weight. As in four of the five previous years, the heifers on the alternately grazed plots gained more than those on the continuously

grazed plot, tho the difference was very small, 236 pounds per acre as compared with 232 pounds. The length of the 1941 grazing season for these pastures was 182 days—from April 11 to October 10. The maximum number of heifers on each pasture was ten, the minimum two, and the average about seven. During the first five years (1936-1940) of this experiment, net gains per acre by the heifers ranged from 196 to 384 pounds with an average of 283 pounds for the continuously grazed pasture, and from 204 to 418 pounds with an average of 305 pounds for the alternately grazed pasture. Pasturage during the first half of the grazing season was largely Kentucky bluegrass and white clover; that during the latter half of the season mostly bluegrass. White clover was somewhat more abundant on the continuously grazed than on the alternately grazed pasture, tho on both it disappeared rapidly after midsummer, and practically none was present during the fall.

Results similar to those with heifers were obtained in duplicate tests with ewes and lambs. In one test lambs grazing with their dams on one-third of their Kentucky bluegrass pasture, and moved to a fresh third at 2-week intervals, outgained by 42.1 percent a comparable group of lambs grazing with their dams on a similar, equal, adjacent area in one unit continuously. In the duplicate test the rotationally-grazed lambs outgained the continuously-grazed lambs by 10.5 percent. The lambs on the rotated pasture gained more than those on the continuous pasture in four of the five years of this experiment.

Effect of shearing late lambs.—Of 20 crossbred lambs that failed to reach market weight by early June, 10 were sheared, the fleeces averaging 2.3 pounds. Both lots were then grazed together in the same field with salt, water, and shade provided at all times. All were drenched every three weeks with the standard dose of cunic mixture. After 98 days grazing the sheared lambs had gained 55.6 percent more weight than the unsheared lambs. The sheared lambs graded "U. S. Good" whereas the unsheared lambs graded "U. S. Medium," on the average.

Creep-fed cracked corn for suckling lambs.—Suckling lambs fed cracked yellow shelled corn in a creep gained as fast as those fed a mixture of 6 parts cracked yellow shelled corn, 3 parts crushed oats, and 1 part pea-sized linseed oilmeal. The lambs fed corn alone made slightly more efficient gains than those fed the grain mixture and reached as desirable a market finish at 100 days. The dams of both lots had been fed liberal rations of shelled corn and alfalfa hay. These results are in close accord with those obtained in 1939 and 1940.

Effect of castrating and docking young lambs on subsequent gains. — Twenty pairs of spring lambs, averaging slightly more than one week old, were so selected that pair mates were identical or closely comparable in breed, sex, age, birth weight, strength at birth, and in daily gain up to the start of the test. All lambs were weighed to the nearest tenth of a pound at the same time each day for an average of six days; then one lamb in each pair was docked or docked and castrated, depending on the sex. Then all lambs were weighed daily for the subsequent week. Docking caused no noticeable setback, but docking and castrating together caused a one-day setback followed by normal gains.

Alfalfa-molasses silage vs. alfalfa hay as roughage for steers on drylot. — Two similar lots of ten western yearling Hereford steers were fed for 147 days in drylot. Lot 1 was fed first-cutting U. S. No. 2 alfalfa hay at the rate of 8.05 pounds per day per steer and U. S. No. 2 yellow shelled corn at the rate of 14.08 pounds. Lot 2 was fed alfalfa-molasses silage made from the same field as the hay and cut at the same time, with 72 pounds of cane molasses added per ton of forage. This lot received 1.7 percent less dry matter in its roughage than Lot 1, but the same amount of shelled corn. The steers fed hay gained 2.25 pounds per steer per day, dressed 58.66 percent, graded low "U. S. Good," and were valued at \$11.39 per hundredweight at time of slaughter. No off-color carcasses were found. The steers fed silage gained 2.42 pounds per steer per day, dressed 57.95 percent, graded "U. S. Good" and were valued at \$11.50 per hundredweight. Several of the carcasses from this lot showed a slight, but not serious, yellowish tinge to the fat. These results substantially confirm those of three previous tests.

Distillers' corn dried grains vs. cottonseed meal as protein supplements for beef cows. — Beef cows suckling young calves during the winter and fed distillers' corn dried grains did fully as well as those fed cottonseed meal as the protein supplement for yellow shelled corn. The former group produced somewhat more milk but did not gain as much in weight. The calves in the two lots made nearly equal gains. From these results, which substantiate those of two earlier tests, 100 pounds of distillers' corn dried grains has a feeding value for lactating beef cows equal to 56.3 pounds of cottonseed meal and 46.7 pounds of yellow shelled corn.

Relationship of relative humidity to hatchability of turkey eggs. — In tests in 1940 the best hatches of turkey eggs were obtained where the humidity was highest, a wet-bulb temperature of 87-88°

F. This year hatchings at this same humidity were compared with those obtained at still higher humidity—a wet-bulb temperature of 89-90° F. The 3,721 fertile eggs from the same source, in 6 settings, were divided into equal lots and incubated under like conditions except for humidity. The dry-bulb temperature was 99.5° F. and the eggs were turned four times daily until the 24th day, when they were transferred to hatching trays. In the hatching compartment all eggs were subjected to a dry-bulb temperature of 99° F., and a wet-bulb temperature of 90-91° F. Weighted mean hatchability for the high-humidity group was 70.8 percent and for the low-humidity group 72.1 percent. Altho the difference was not statistically significant, the low humidity treatment gave higher hatches in four of the six settings.

Simplified methods of feeding poultry.—During the season of 1940-41 the “simplified rations” were fed thruout the laying period as well as the growing period. The methods of feeding were (1) a protein supplement and yellow corn in separate hoppers, and (2) a mash composed of 50 percent of the protein supplement and 50 percent ground yellow corn in one hopper, and shelled yellow corn in another hopper. There was no significant difference in egg production, hatchability, or egg weight as a result of these methods of feeding.

During the season of 1941-42, the cafeteria method of feeding chicks and laying pullets is being compared with the mash-and-grain method. Both broods were started on a well-balanced starting mash for four weeks. One brood was then given mash and grain, both hopper fed, and the other brood was transferred to a “cafeteria” type of ration consisting of yellow corn with 1 percent cod-liver oil added, meat scrap plus 2 percent salt, and soybean oilmeal, all in hoppers, and lespedeza hay in racks. The pullets raised in the two broods were continued on the same feed during the laying year. So far (first two months of the laying year) there has been very little difference in production by the two groups of pullets.

Control of poultry lice.—Previous work at this Station indicated that 40-percent nicotine sulfate was the best all-purpose material for control of chicken lice. In tests of dosages of .3 cc, .6 cc, and .8 cc of 40-percent nicotine sulfate, applied to roosts, at temperatures of 57° to 62° F., and of dosages of .3 cc and .6 cc at temperatures of 47° to 59° F., all dosages were equally effective. Kills of body and shaft lice in the tests ranged from 97.6 to 100 percent. Most recommendations suggest a minimum dosage of one ounce of

40-percent nicotine sulfate to each 60 feet of roost, but from these tests it appears that equally good control could be had with one ounce used on 150 feet of roost.

Changes in the egg yolk fat during incubation as influenced by the hen's ration. — Two lots of Rhode Island Red hens were fed rations which differed mainly in that the feed of one lot contained 36.7 percent starch while that of the other contained only 7.3 percent starch. The ration of the first lot contained twice as much starch as protein and that of the other only one-fourth as much starch as protein. Eggs laid on alternate days were analyzed, whereas those laid on the other days were incubated, and immediately after hatching the chicks were killed and the yolk-sacs with their contents removed and analyzed in the same way as the eggs. The quantity of yolk fat used by the developing embryo was slightly larger in the lot from hens fed the ration containing the larger percentage of starch. The iodine number of the fat in the fresh yolk and yolk sac also was larger in the eggs from hens fed the smaller percentage of starch. Hatchability seemed not to be influenced by the rations.

Quality of Kentucky cream. — As a basis for recommendations that might lead to improvement in quality of Kentucky cream, 2,294 samples of cream delivered at Franklin were examined as to age, taste, and smell, methylene blue-borax (MBB) test, and sediment test. Of these samples, 1,444 were picked up on cream routes and 850 were delivered by the producers to cream stations. Examinations were made February 15, May 17, August 16, and November 15 to note seasonal differences. Of all samples, 64.7 percent were 4 days old or less when delivered; the percent of such samples being smallest in February (47 percent) and the largest in August (77 percent). A much larger proportion (67 to 86 percent) of the samples taken on cream routes than of samples delivered to stations (28 to 61 percent) was 4-day cream. As to taste and smell, the percentages of all samples graded "first," "second," and "reject," were 53.1, 42.4, and 4.5 percent respectively; and there were no significant differences between the route and station samples. The percentage of samples graded "first" on taste and smell was highest (66 percent) in November and lowest (37 percent) in May. In the MBB tests, a higher percentage of the station samples than of the route samples were "good" or "fair" in February, August, and November, but not in May.

No marked trends were evident from the sediment test. The percentages of "clean" cream were February, 24.6; August, 24.5; May, 10.7; November, 15.3. The percentage of "clean" route samples was slightly higher than the percentage of "clean" station samples.

Virus abortion of mares.— During the winter of 1940-41 attempts were made to protect pregnant mares from virus abortion on farms where abortion had occurred by injecting a vaccine prepared from the liver of one of the aborted fetuses. Outbreaks occurred on five farms in central Kentucky. On one farm 15 mares were vaccinated after three mares had aborted. Seven of the fifteen mares aborted after vaccination, however, all within the period of incubation of the disease. On the other four farms, 41 mares were vaccinated immediately following the first abortion on the farm, and no further abortions occurred.

During the fall of 1941 a total of 116 pregnant mares were vaccinated in controlled experiments on six farms of central Kentucky. Controls were established by vaccinating half of the pregnant mares on each farm. Liver-tissue vaccine was used, each mare receiving three injections intradermally at intervals of five to seven days. Results of these vaccinations are not yet definitely known.

Periodic ophthalmia.— Studies were made during the year of transmission of periodic ophthalmia by natural exposure and by inoculation. Facilities consisted of a barn with 12 box stalls and of three paddocks ranging in size of from 1 to 3 acres. From 1936 to date the barn was not disinfected nor fumigated but the stalls were cleaned as would be done in any stable for horses. From June 1936 to December 1941 a mare affected with acute periodic ophthalmia in one eye remained in this barn more or less continually, and ten other horses affected with periodic ophthalmia were in the stable and in the paddocks for shorter periods: 1 for three years, 1 for two years, and 8 from one to twelve months.

During a period of five years 38 other horses, mostly young animals, were kept in the stable and paddocks with these 12 horses suffering from periodic ophthalmia. The periods of time during which the 38 normal experimental animals were thus naturally exposed ranged from a few months to five years, but not one case of periodic ophthalmia has, to date of writing, developed in the normal experimental animals.

In inoculation experiments 32 of the normal animals kept in the paddocks or stable were inoculated with material from the eyes of horses affected with periodic ophthalmia. Intrapalpebral, intravitreous, intravenous, and subcutaneous injections were made. Furthermore, ascarides, strongyles, cylicistomes and anoplocephales, respectively, were collected from horses affected with periodic ophthalmia, ground up and administered intravenously and by mouth to young animals with normal eyes. In addition to these direct inocu-

lations, flies and mosquitoes were tested as vectors. Flies were allowed to feed on the fluid and tissues of enucleated diseased eyes and then placed in a screen fastened over the head of a horse. Mosquitoes were placed in a net over the head of a horse suffering an acute attack of periodic ophthalmia. After several hours the net containing the mosquitoes was transferred to the head of a horse with normal eyes. Many other methods of exposure likewise were tried. None of these horses, however, developed symptoms of the disease.

Incoordination (wobbles) in young horses.—Chemical and spectrographic analyses of samples of rib, liver, vertebrae, and spinal cord of normal and of diseased horses were continued this year. No significant correlation was found, however, between the diseases and any of the fourteen elements studied.

Since one of the clinical manifestations of incoordination in horses is a hemorrhagic condition in the tissue surrounding the spinal cord, a study was made of the ascorbic acid content of the spinal fluid, blood, eye fluid, and semen. Samples were analyzed for ascorbic acid of both normal and diseased horses. On an average the ascorbic-acid content of the aqueous humor in the animals afflicted with incoordination was 58 percent less than in normal animals, and of the spinal fluid, 23 percent less than the normal. In treatment, feeding of pure ascorbic acid did not materially increase the amount of ascorbic acid in the blood. Better results in this respect were obtained by subcutaneous injection of the ascorbic acid. Intravenous injection was not as effective as subcutaneous injection. Two hours after intravenous injection of 10 to 20 grams of the pure compound, the ascorbic-acid level in the blood was no higher than before the injection.

Corynebacteria in domestic animals.—Study of the characteristics of the *Corynebacterium equi* organism was continued during the year, and *Corynebacterium ovis*, found in an abscessed mediastinal lymph gland of a ewe, was isolated for the first time by this laboratory. *Corynebacterium equi* was shown to be capable of utilizing glucose without producing detectable amounts of acid or gas. Altho not pathogenic for the common small laboratory animals the micro-organism produced a fatal infection in chick embryos. By complement fixation tests, all the bacilli were shown to possess species-specific antigens, and by agglutination tests 29 of the 34 cultures studied were placed in 4 serologic groups divisible by agglutinin-absorption tests into at least 19 serologically distinct types. Cultures from the genital tract of mares, from aborted fetuses, from foals

having pneumonia, and from submaxillary lymph glands of hogs belonged to the same serologic group.

Paratyphoid bacilli.—In the study of the epizootological distribution of Salmonella types, 884 cultures were classified of which 604 were isolated from domestic animals and 280 from man. Three new serologic types were recognized and their antigenic constitution determined. These new types and their antigenic formulae were *S. illinois*—(III) (X V) XXXIV : z_{10} —1,5; *S. amherstiana*—(VIII) : 1(v)—1,6; and *S. salinatis*—IV XII : d e h—d e n z_{15} . The latter species was transformed into a type indistinguishable from *S. san diego* by growth in immune serum. This is the first instance in which the transformation of Salmonella types has been demonstrated. Two additional undescribed types are now under study.

Three species not hitherto recognized in the United States were encountered: *S. rubislaw*, *S. chester* and *S. cerro*. *S. cerro* previously had been recognized only in South America. *S. rubislaw* was recognized in animals for the first time; and *S. manhattan*, *S. saint paul* and *S. abortus equi* were recognized for the first time among cultures isolated from man. Two cultures isolated from man were identified as *S. pullorum*, and one was associated with gastro-enteritis. Association of *S. pullorum* with gastro-enteritis of man is significant inasmuch as the bacillus occurs frequently in poultry and eggs. *S. pullorum* also was isolated from ulcerative colitis in a pig. This is the first authentic record of the isolation of *S. pullorum* from man and swine. *S. cholerae suis* var. *kunzensdorf*, which occurs commonly in swine, was isolated from the ovary of a hen.

ORCHARD AND TRUCK CROPS

Sod cover or cultivation for orchards.—Since 1926 studies have been under way to determine whether apple orchards on moderately sloping ground should be cultivated or kept in sod; and since 1928 similar studies have been made of peach orchards. The cultivated plots have had both spring-planted and fall-planted cover crops for turning under.

Until two years ago the trees on the cultivated plots in the apple orchard made a more rapid growth and produced heavier yields than those on the plots in lespedeza sod. The past two years, however, the trees on the sod plots have made the greater growth, have had the larger leaves, heavier foliage, and larger and higher-colored fruits. Likewise they have in most cases produced a heavier yield per tree than those on the cultivated plots. In the peach orchards,

both on limestone and on sandstone soil, the trees on plots having sod cover are now showing greater vigor and heavier production than those on the cultivated plots, tho in the early years of the orchard those on the clean-cultivated plots had the higher production. Only on the most nearly level and most fertile of the cultivated plots have the trees remained as vigorous and productive as those on the sod-covered plots.

Greater loss of soil by erosion from the cultivated plots than from the sod plots was evidently the main reason for the declining productivity and vigor of the trees on the cultivated plots.

Early varieties of apple.—A number of extra early varieties of apples tested at the Station have attracted much attention from apple growers of the state. The Close, Red Bird, and Lodi varieties received much favorable comment from growers who attended the field meeting on August 14th. Because of the favorable market for early-ripening apples and the smaller expense for pest control on these than on later varieties, the trend of apple production in Kentucky is toward early varieties.

Red raspberries.—In the dry season of 1941, plots of Latham red raspberries mulched with straw at the rate of 20 tons per acre yielded at the rate of 87 crates per acre more than similar unmulched plots. Mulched but unsprayed plots yielded slightly more than plots sprayed with bordeaux and cultivated. Plots both sprayed and mulched yielded most. These results are in line with those of other dry years. Fertilizing with nitrate of soda, at all rates used, reduced the yield in both mulched and unmulched plots.

Corn ear-worm control.—Clipping the end of corn ears infested with corn ear worms had been found in former years to be a very satisfactory method of control. In 1941 this method was compared on 6 plantings of sweet corn, with an oil-treatment which had been tried and recommended by the U. S. Department of Agriculture and some state experiment stations. In these tests, however, the clipping method was by far the best in every trial. Worm infestation was reduced 72 percent by clipping and 47 percent by oil treatment. The clipped ears were clean and their appearance for market not materially harmed. Oil-treated ears on the other hand were unattractive, and it was necessary to remove the tip of the ear to avoid an oil flavor when cooked.

Spraying lima beans.—Because of the effectiveness of naphthalene acetic acid spray in reducing preharvest drop of apples, this spray was tried this year in an effort to reduce blossom drop on lima beans. Blossom drop was reduced, and in the first harvest (about

30 days after spraying) the sprayed plots yielded 41 percent more than those not sprayed. At later picking dates, however, this advantage seemed to disappear, probably because the spray was effective only a short time, a characteristic found also in its use on apples.

Effect of potassium iodide on the ascorbic-acid content of tomato plants.—Tomato plants were grown in sand cultures containing an appropriate nutrient solution. Potassium iodide was added at the rate of 4 to 100 parts per million to some of the cultures. In every instance the plants which received potassium iodide contained less ascorbic acid (vitamin C) than the plants growing in the cultures to which no potassium iodide was added.

Firmness of canned fruits and vegetables.—A quality of fresh fruits and vegetables not found in some canned fruits and vegetables is firmness of body tissue. During 1939-1940 investigators reported that addition of calcium salts improved the firmness of canned tomatoes. Therefore, this year, the tissue structure of asparagus, rhubarb, strawberries, red raspberries, plums, and gooseberries canned with levels of calcium chloride at 0.05 percent, 0.07 percent, and 0.09 percent was studied. If the juice of the fruit or vegetable can be held within the cells, by forming a gel rather than diffusing out during the canning process, the amount of juice drained from the fruit will be less and the fruit will be firmer. Comparison of the weight of the fruit before and after canning indicates how much water was retained. There is a direct relation between the "percent drained weight" and firmness. Plums, gooseberries, and asparagus have a good protective coating on the outside. In asparagus stalks the calcium chloride would probably diffuse toward the middle from each of the cut ends more rapidly than thru the outer covering of the stalk. In these tests, however, no more water was retained in asparagus when calcium chloride was added. When calcium chloride was added to peeled rhubarb the juice of the canned rhubarb was very opaque and crystals were formed thruout. The calcium may have united with the oxalic acid to form calcium oxalate, rather than with pectic acid to form calcium pectinate. While strawberries and raspberries are not covered with a protective coating, the addition of calcium chloride in various amounts did not increase the percentage drained weight. When raspberries were canned with added water, the addition of calcium chloride definitely increased the amount of water retained as measured by the percentage drained weight. The firmness of tissue structure and "standing up" quality of the fruit was improved.

A committee judged these products for flavor and texture. The addition of calcium chloride did not affect the flavor of raspberries, gooseberries, or asparagus, nor did it affect the flavor of strawberries, plums or rhubarb until the concentration of the calcium chloride was increased to 0.09 percent. The addition of calcium chloride did not affect the texture of asparagus, gooseberries, or strawberries. The texture of plums was improved at all levels of calcium chloride tested. The texture of rhubarb to which 0.07 percent calcium chloride was added was given the highest score by the judges, that with 0.05 percent the next highest and that with 0.09 percent the lowest. The score for the texture of raspberries canned without added water increased slightly as the percentage of calcium chloride increased. The improvement in texture when calcium chloride was added to plums, rhubarb, and raspberries was not parallel to changes in drained weight. The texture of raspberries canned with added water was improved with each increase in the percentage of calcium chloride, and in this case the improvement paralleled the changes in drained weight.

INSECT CONTROL

Control of tomato fruitworm.—In a test for control of the tomato fruitworm, 5 insecticidal mixtures were applied to replicated plots of tomatoes—6 replications of each treatment and 6 checks or untreated plots. The materials tested were a spray made of 4 pounds of lead arsenate in 100 gallons of water; a cryolite-talc dust containing 70 percent of sodium fluoaluminate; a bait made of 1 pound of lead arsenate and 10 pounds of cornmeal; a cryolite-cornmeal bait, made of 1 pound of cryolite and 10 pounds of meal; and calcium arsenate dust, undiluted. Treatments were made on June 6, 14, 17, and 27; the first fruits were picked on June 23, and the heaviest infestation by worms occurred between June 23 and July 17, when prices for the fruits were high. None of the treatments gave full control, but all were fairly effective. The average percentages of injured fruits thru July 17 under the different treatments were as follows: lead arsenate spray, 8.8 percent; cryolite-talc dust, 9.4 percent; lead arsenate-cornmeal bait, 8.2 percent; cryolite-cornmeal bait, 8.2 percent; calcium arsenate dust, 8.1 percent. On the untreated plots, 22.1 percent of the fruits were injured.

Control of green June beetle grubs in bluegrass.—In one series of plots, 72 cc of 2, 2¹ dichloroethyl ether with 9 cc of Tergitol "7" (a penetrant) in 2.25 gallons was applied to each of four plots

of bluegrass sod. The average control of green June beetle grubs was 93 percent. The same amount of the ether and water with 4.5 cc of Tergitol "7" gave a control of 90 percent in one series of plots, 75 percent in another series, and 73 percent in a third series. Without Tergitol "7" the same amount of ether and water gave a control of 70 percent in one series of plots and 68 percent in a second series. The ether used at the rate of 32 cc in one gallon of water on each plot without Tergitol gave a control of 23 percent in one series of plots. Sodium cyanide used at the rate of 13.3 grams in 2.25 gallons of water on each plot gave a control of 87 percent. No injury to bluegrass was evident where the chemicals were properly applied.

Control of green June beetle grubs in tobacco beds.— On 5 plots, each containing 25 green June beetle grubs, in a tobacco bed, a bait made of 25 pounds of alfalfa meal and 1 pound of paris green was applied at the rate of 10 pounds moist bait to 100 square yards of bed. On 5 similar plots another bait made of 96.5 pounds of dried apple refuse and 3.5 pounds of sodium fluosilicate (a patented bait) was applied dry at the rate of 10 pounds to 100 square yards. On 5 other similar plots no bait was used. The alfalfa meal bait killed 32 percent of the grubs and the apple bait 75 percent. As only about 80 percent of the grubs in the soil come to the surface where the bait is placed, the control obtained with the apple bait was very good.

Tests of oil-nicotine spray for insects.— In tests of 2-percent free nicotine in oil, atomized, at an air temperature of 79° to 80° F., the material killed within 24 hours 95.5 percent of the willow aphid on which it was tried. With atomized oil alone 19.9 percent of the same kind of aphid were killed. Mexican bean beetle adults were unaffected by atomized 2-percent free nicotine in oil when treated in the insectary at air temperatures of 76° to 78° F. and 79° to 80° F. Similarly practically no kill of either striped or spotted cucumber beetles occurred in field tests with atomized, 2-percent oil nicotine at an air temperature of 72.5° F.

Control of white grubs in bluegrass sod.— The study of 2, 2¹ dichloroethyl ether solution for the control of *Phyllophaga* larvae in bluegrass sod was continued. Five series of tests were made, three of treatment of infested sod in the field under natural conditions, and two of treatment of stocked plots. Addition of small amounts of Tergitol "7" penetrant to dichloroethyl ether solutions did not increase the kill of grubs significantly, but lessened the danger of injury to bluegrass by making a more uniform mixture.

On August 20, 12 plots, each 10 feet square, were treated using

a 200-gallon power sprayer; 4 plots treated at a rate of 1 gallon dichloroethyl ether solution per square yard and 4 others at the rate of 2 gallons per square yard. Each gallon of solution contained 32 cc of ether and 2 cc of Tergitol "7" penetrant. Sodium cyanide solution, 10½ ounces to 50 gallons of water, was applied to the third series of four plots, at the rate of 2 gallons per square yard. The soil was fairly dry and the temperature just beneath the sod ranged from 68° to 75° F. Between August 25 and 28 as many 1/40,000th acre units were dug in each plot as was necessary to yield 25 grubs, dead or alive, the number of units ranging from seven to 26 per plot. Good control was obtained with both the dichloroethyl ether solution (85.1 percent) and the cyanide solution (80.9 percent) at the rate of 2 gallons per square yard. The ether solution at the 1-gallon rate gave poor control (22.2 percent). No injury to bluegrass from the treatments was noted.

May-beetle control.—A number of pin, bur, and chinquapin oak trees were partly or completely stripped of their leaves on Inner Bluegrass farms, the first week in May. On the night of May 1, ten pin oaks that were being stripped were examined and 1,496 May beetles removed by shaking the trees. Examination of this sample showed that the species responsible for most of the damage, as in other years, was *Phyllophaga hirticula*, to which species 83.6 percent of the beetles belonged. The remaining beetles were *Ph. fulilis*, 12.1 percent; *Ph. tristis*, 1.6 percent; *Ph. inversa*, 1.5 percent; *Ph. fusca*, 1.1 percent; and *Ph. bipartita*, .1 percent.

Two experiments were run in which equal numbers of males and females of *Ph. hirticula* were allowed to feed for two nights on poisoned pin-oak foliage. Lead arsenate, 4 pounds to 100 gallons of water, killed 79.2 and 62 percent of the males while basic copper arsenate at the same rate killed 66.4 and 54 percent. Lead arsenate killed 67.2 and 30 percent of the female beetles while basic copper arsenate killed 71.2 and 18 percent.

Methyl bromide fumigation for control of strawberry crown borer.—Fumigation tests with crown-borer eggs and adults were repeated this year using a 50-cubic foot iron fumigator built according to specifications suggested by the Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture. As in previous work, fumigation with 3 pounds of methyl bromide per 1,000 cubic feet for two hours at chamber temperatures of 70° F. or above gave 100 percent kill.

Fumigated strawberry plants were grown in a greenhouse and on farms in several of the berry-growing areas of the state, and their

growth was compared with that of unfumigated plants. The Blakemore variety was less affected by fumigation than Premier. Both varieties showed little or no after-effects of fumigation with 3 pounds of methyl bromide per 1,000 cubic feet for two hours at temperatures between 68° and 80° F. Blooming of Premier and Blakemore plants was prevented by fumigation at a temperature of 73° F. or above with 3 pounds of methyl bromide per 1,000 cubic feet for four hours. Such de-blooming of spring-dug plants appeared impractical, however, because the growth of runners and runner plants after the plants were set out was severely retarded.

Other insects. — Corn ear worm, page 30; poultry lice, page 25.

FARM ORGANIZATION AND MARKETING

Farm management in the southwestern Pennyroyal region. —

In a study of some 6,000 farms in the southwestern Pennyroyal region the following facts with respect to management of the farms were outstanding:

(1) The amount of feed produced per acre can be greatly increased on these farms while also increasing the fertility of the soil.

(2) For many of the farmers main emphasis on crops gives the best use of available resources, especially of management.

(3) Farm layout and field arrangement on most of the farms are not adapted to systematic rotations nor to livestock farming.

(4) On practically no farms in the area does a single rotation bring about the best use of the land.

(5) Greatest difficulty with small farms is adapting enterprises to the particular ability of the operator. Intensive use of the land, short rotations, intensive livestock enterprises, and purchase of feeds to add to those grown on the farm are necessary to success on the small farms.

(6) Regarding the dark tobacco problem these studies show that by using new rotations, increasing livestock numbers, and using more or better soil treatments, farmers in the area are obtaining incomes equal to or greater than where dark tobacco is mainly emphasized.

(7) Alfalfa should be grown on practically every livestock farm.

Adjustments for loss of income from dark tobacco in western Kentucky. — Since 1920 western Kentucky has suffered severely as the result of declining demand for dark tobacco. From studies of adjustments to meet this situation, the greatest promise seemed to lie in more complete utilization of available farm resources, better rotations, higher yields, better balance between crop and livestock

enterprises, and more adequate production of things for home consumption, rather than in the introduction of new farm enterprises.

Land tenure and farm tenancy.—During the year a summary was made of Kentucky laws dealing with farm tenancy, and suggestions were offered for improving landlord-tenant relations. Means of improvement were the codifying and clarifying of existing laws; wider use of arbitration in settling disagreements between landlords and tenants; an educational program on landlord-tenant relations; adequate, written leasing agreements; amendment of the statute of frauds; longer notice of the termination of leases; and modifying the present law concerning the landlord's lien. The summary of present laws and suggestions for improvement were published in Bulletin 418, "Legal Aspects of Farm Tenancy in Kentucky," of this Station.

In another study of land tenure in Kentucky 9 type-of-tenure areas were outlined, the characteristics of each described in detail, and the important tenure groups and subgroups inventoried and described. Of the total rural population of Kentucky, nearly 389,000 persons were in 1940 directly engaged in operating farms or were employed in work on farms. Of these, about 178,100 were owner operators, about 35,200 operating tenants, about 48,600 share croppers, about 73,700 wage workers, and about 53,143 unpaid family workers. There were landlords of various descriptions comprising 19 percent of all owners, and owning 23 percent of all farm land in the state, but not themselves actually engaging in farming. There were also mortgage holders having rights as creditors on 43,537 of the 160,307 owner-operated farms of the state.

Cost of tractor operation.—Costs incurred in operating 43 tractors on farms in Union and Henderson counties in 1940 were compared this year with the costs of operating 36 tractors in Christian and Todd counties in 1930. Operation costs had declined during the ten years. Depreciation was still the major item of cost, followed closely by fuel and oil expense.

Tractor cost per acre of crops or per day of use was relatively high on some of these farms because the tractor was not used enough. When a tractor is used only 25 or 30 days a year the costs for fuel and oil are no higher per day or per acre than when it is used 100 days or more, but the costs for depreciation and interest per unit of use are considerably higher.

Cooperative marketing of wool in Kentucky.—Farmers' cooperative associations in Kentucky have marketed wool since the early beginnings of commercial sheep production in the state. In

1940, 6 local wool pools and one state-wide cooperative association operating in Kentucky marketed 632,000 pounds of wool, or 11 per cent of the state wool clip. As shown by a study completed in 1941, success of these associations depends on ability to sell wool, economy of operation, rendering of market services, or a combination of these factors. Buyers pay higher prices for wool sold by the associations because it is graded, properly packed, and offered in comparatively large lots. The fact that members of the associations donate labor in handling the sale makes for low cost and efficient handling, while provision of proper sacks and twine by the association, giving instruction on the preparation of wool for market, and assurance of payment for wool make the cooperative method of sale attractive to the growers.

A survey of wool growers in the state revealed that farmers generally favor the cooperative method of selling wool but that they sometimes do not support it for the following stated reasons: (1) inconvenience of a long wait for final settlement; (2) insufficient information about the affairs of the association; (3) unsatisfactory grading; (4) absence of convenient receiving stations or local cooperatives; (5) high handling costs; and (6) excessive shrinkage in wool. These objections to marketing wool cooperatively take on relatively great importance in Kentucky where wool is grown chiefly as a side-line enterprise and the volume of wool grown on a typical farm is relatively small.

Returns from beef-cow herds.—In beef-cow herds in Union, Christian, Todd, and Logan counties the value of calves produced ranged from \$25 to \$43 per cow, with an average of \$35. Feed cost was 75 percent of the total cost in producing these calves, and ranged from \$13 to \$33 per cow, averaging \$23. Harvested roughage, the largest single item of cost, accounted for 44 percent of the total cost. Roughage costs could be lowered on many of the farms studied by eliminating wasteful feeding practices, making better use of corn stover, and providing pastures that furnish adequate grazing in early spring and late fall.

On 47 farms in Union and Henderson counties returns in 1941 from beef cattle averaged \$116 for each \$100 of feed used. Cost of producing beef was greater than the returns in two years (1933 and 1934) of the eight years 1932-1939. For the other six years net returns ranged from \$4 to \$11 per cow.

Changes in market outlets for Kentucky livestock.—Growth of livestock auction markets in Kentucky since 1922 has had repercussions on the whole livestock-marketing organization of the state.

In 1939 the 43 auction markets in operation handled a larger share of the livestock sold by Kentucky farmers than any other type of market. Some 352,000 cattle, 215,000 calves, 610,000 hogs and pigs, and 626,000 sheep and lambs were sold at the auction markets. The market outlets most adversely affected by the diversion of receipts to auction markets were three of the four nearby terminal markets, livestock dealers, and packer buyers purchasing from farmers for shipment to Eastern markets. At the terminal market at Cincinnati only 50 percent as many cattle, 43 percent as many calves, 32 percent as many hogs, and 49 percent as many sheep and lambs were sold from Kentucky in 1936-1940 as were sold in 1921-1925. Reductions in receipts of Kentucky livestock at the terminal market at Louisville were heaviest during the early thirties, tho declines in receipts of hogs continued thru the thirties. Receipts from Kentucky to the terminal markets at Nashville have declined until only a small quantity is sold there now. Many livestock dealers and packer buyers who formerly bought large numbers of livestock in the more concentrated areas of production either discontinued buying or transferred their buying operations to the auction markets.

Auction markets as outlets for Kentucky livestock. — An important quantity of the livestock sold at the auction markets of Kentucky in 1939 was slaughter livestock. Slightly over 53 percent of the cattle, 66 percent of hogs and pigs, 94 percent of the calves, and 95 percent of the lambs were sold for slaughter. Of this *slaughter* livestock, order buyers and packer buyers bought 65 percent of the cattle and over 90 percent of the calves, hogs, sheep, and lambs. These buyers were purchasing primarily for shipment to eastern packers and to a lesser extent for packing plants located in Kentucky and nearby states. Speculators purchased the rest of the slaughter animals for resale at the auction markets, the terminal markets at Louisville, Cincinnati, and more distant cities, or to the packing plants.

Forty-seven percent of the cattle sold at the auction markets, 34 percent of the hogs and pigs, 6 percent of the calves, and 5 percent of the lambs were sold for grazing, feeding, or breeding. Hogs and pigs, calves, sheep and lambs not sold for slaughter were purchased mainly by Kentucky farmers tho some feeder pigs were purchased by livestock dealers and farmers for shipment to Ohio, Indiana, and other nearby states for feeding. Large numbers of stocker-feeder cattle sold at the auction markets were purchased by speculators who resold the cattle primarily at the auction markets. Farmers of Ken-

tucky mainly and farmers in Ohio, Indiana, and Illinois are the eventual buyers of these cattle.

Organization of tobacco auction markets.— By 1920 some 60 loose-leaf tobacco auction markets were operating in Kentucky, but during the next two decades more than half of these, particularly the smaller ones, ceased to operate. Most of those which ceased operation were burley markets located between the Ohio river and the central part of the state. Some failed because they had been established without sufficient forethought to the size of the supply area and the potential volume of business available for efficient operation. Often local business interests encouraged the establishment of tobacco markets to keep the farmers' buying power at home.

The drastic decline in production of dark tobaccos during the past two decades has materially reduced the need for tobacco marketing facilities in western Kentucky. Declining production in some sections of the burley-producing area likewise, has left some markets with a very small volume of business. Rapid development of hard-surfaced highways and increased use of trucks for transporting tobacco to market have increased competition between markets to such an extent that profitable operation of some of the smaller markets is no longer possible.

Strong competition between markets has also encouraged many readjustments in the internal organization and operating practices of individual markets. More cooperative effort has been resorted to by warehousemen at a given market center to improve the auction sale service of that market and strengthen its competitive position with other markets. Greater centralization of warehouse ownership has occurred within the market to gain greater economy in warehouse operations. Increases in warehouse sale-floor space have been made in some markets in an effort to serve farmers' demands for prompt sale of tobacco. Slow increases in warehouse sale charges to cover rising overhead costs have accompanied the expansion of investment in warehouse facilities.

Trends in demand and consumption of U. S. tobaccos.— During the year a study was completed dealing with the demand for U. S. tobaccos in recent decades and the present indications of trends in future demand. Tobacco growers now are of course interested chiefly in prospects for the future. From evidence gained in this study the following predictions can be made. Doubtless the continent of Europe, the principal market for dark tobacco in recent years, will remain almost entirely cut off from trade with the United

States for the duration of the war. The same may be said of China and most of the other markets for flue-cured tobacco in the Far East. Altho the United Kingdom, by far the most important importer of United States flue-cured tobacco, remains open to trade, the transfer of British economy to a complete war footing, the shipping difficulties, and the complete regulation of foreign trade in the interest of the war effort have reduced British takings of American flue-cured tobacco to a small fraction of their pre-war volume. Tho the application of Lend-Lease to tobacco and the increased cooperation of Britain and the United States in the conduct of the war no doubt will bring about some measure of recovery in such exports to the United Kingdom, it appears unlikely that they will reach the pre-war volume in the near future.

The present war will doubtless have far-reaching long-time as well as immediate consequences for United States tobacco producers. In the domestic market which takes most of the burley produced, expanding consumption of tobacco products, particularly cigarettes, probably will continue during the war period. After the war, however, the rate of increase probably will slow down, largely because of a lower rate of increase in population and probable higher prices for tobacco products. The current shift in consumer taste and preference from products of the dark strong types of leaf toward cigarettes and light smoking mixtures made from flue-cured and burley tobaccos probably will continue, tho not on as great a scale as recently.

Future trends in foreign consumption of U. S. tobaccos will depend largely on general economic policies adopted by the principal trading nations. If, as after the last war, reconstruction is followed by intense economic nationalism in which the various countries erect competitive trade barriers to isolate their respective economies, there can be no doubt that exports of U. S. tobacco will shrink materially below recent levels. On the other hand, if international cooperation involving the elimination or material reduction in trade barriers can be brought about, there probably will be a large market for American tobaccos in an expanding world economy.

There are, however, certain very definite influences unfavorable to an increase in exports of U. S. tobacco over a long period of time. One of these is the prospect of a declining rate of increase in population in western Europe. Another is the likelihood that the long tradition in favor of government regulation of the tobacco trade, and powerful vested interests created by such regulation and protection, will strongly resist reduction in trade barriers. Furthermore, once

the production of a commodity has been established on a relatively high level, the withdrawal or modification of protective measures usually does not cause production to decline to former levels. These factors, and others unfavorable to U. S. tobacco exports probably will outweigh favorable developments unless policies to free international trade and to expand economic activity thruout the world are applied very broadly and effectively.

RURAL LIFE STUDIES

Growth of Kentucky population, 1860-1940.—In preparation for studies of the relation between population and various social and economic conditions, a history of changes in population in the 120 counties and 10 social subregions of Kentucky since 1860 was compiled.

Thru these 80 years the population of Kentucky as a whole grew continuously and at a relatively constant rate. In each of the ten subregions, also, the population grew rather consistently until about 1900, after which time some of the areas continued to grow while others declined.

The Cumberland Plateau (mountain) subregion grew thruout the 80 years more rapidly than the state as a whole or any other subregion, and with no retardation until 1930, and by 1940 it contained more people than any other of the ten subregions. Its rapidity of growth was equal to that of the United States, into which so many immigrants were moving prior to the 1920's. Increasing at first almost as rapidly as the mountain area were the Highland Rim and Cumberland Plateau Margin (foothills and knobs) and the Metropolitan area (Louisville and Covington); but rates of growth in both these areas dropped slightly about 1900.

In the other subregions (including the Inner Bluegrass area, except Fayette county), a relatively complete settlement has existed for periods ranging from 30 years in the Western Coal Field and Purchase areas to 60 years in the Outer Bluegrass. There have been some gains and losses of total population in each area, but thruout the period there has been a general tendency to vary only slightly around a general average. Major shifts in resources, methods of exploiting the resources, or standards of living would undoubtedly bring a change in these relatively stable numbers.

In the mountains, foothills, and knobs it is evident that even with allowance for the development of coal mines, railroads, and highways,

present levels of living might be higher had population not continued to grow after 1920.

Community organization.—In collaboration with the Agricultural Extension staff on land use planning, staff workers in rural sociology assisted in the delineation of neighborhoods and communities in some 33 counties of the state. For each of 16 counties a "Preliminary Report on Neighborhoods and Communities," including an analysis of population trends in each county, was prepared. In a special study of neighborhood and community structure in thirteen counties 666 neighborhoods were found and delineated. The number of neighborhoods per community ranged from 1 to 13, and averaged 4.6. Roads were of much importance in determining the size of neighborhoods and the number of neighborhoods in a community.

Land-use trends in the Eastern highland region, 1929-1939.—Rapid increase of population in the eastern highlands of Kentucky is making necessary important changes in land use in that region. During the year a study was made of land use in Knott county, an area in general representative of the region. During the thirties the number of farms in Knott county increased 36 percent. As this increase came about mainly thru division of farms, the average size of farms declined 30 percent during the period. On the subdivided farms the problem of maintaining an adequate volume of production became more acute.

The farm economy of the region is primarily the production of food and other materials for home use. More land was cleared and a larger proportion of the land used for cultivated crops. On many farms there was greater use of soil-conserving practices, but the tendency in this direction was not adequate to offset the effects of bringing additional land under cultivation on the smaller farms. As a result of these adjustments fewer products were produced for sale and more of the farms than previously were reduced to a subsistence level.

Income from nonfarm employment, chiefly coal mining, is a major factor in the income of farmers in this region. Income per capita from outside employment was maintained at about the same level as before, only by a substantial amount of employment on public-works projects.

ANALYSIS, INSPECTION, AND CONTROL SERVICES

Public Service Laboratories.—The work of the Public Service Laboratories was along the same lines as heretofore, but the volume

has increased materially. This year, 39,702 specimens were examined, or 5,834 more than in 1940. The drug laboratory examined 366 specimens; the food laboratory, 2,385; and the bacteriological laboratory, 36,951. Of the latter, 7,239 were in the examination of food handlers for the State Department of Health. Obviously, on such volume of work it is not practical to report in detail. Of special interest, however, were a 50-percent increase this year in the number of specimens for enteric diseases and a 25-percent increase in the number positive; a decline in the percentage of positive reactions to gonorrhea from 23.2 percent in 1940 to 17.4 percent this year; an unusually heavy demand for bacteriological examination of waters occasioned largely by rural people being forced by several years of diminished rainfall to use water from sources of doubtful purity; and the occurrence for the first time of positive reaction (2 cases of 5 submitted) for Rocky Mountain spotted fever among specimens sent to this laboratory.

Nursery inspection. — The trend toward increased use of ornamental nursery stock has continued in 1941 and has been given added impetus by the program now developing to make use of plants in screening objects of major importance to national defense. Another significant trend is toward elimination of regulations classed as interstate trade barriers.

During the year the nursery inspector has traveled 25,112 miles for inspecting stock and enforcing regulations governing its movement. During that time he has made 114 regular inspections, including, 1,032 acres of nurseries, 28,540 square feet of sweetpotato plant beds, and 1,210 bushels of sweetpotatoes in storage. Certification was refused on six fields of strawberry plants because of the presence of crown borer or yellows (on Blakemores) and on two storage houses of sweetpotatoes because of black rot.

Only one Japanese beetle was captured in the traps in the Louisville area during 1941. This decided reduction from the peak of 63 beetles caught in 1938 furnishes ample proof that the eradication work conducted by this Station in cooperation with the Bureau of Entomology and Plant Quarantine, the City of Louisville, and Jefferson county, is giving satisfactory results.

Webster is the only county in Kentucky now considered infected with phony peach disease and for two successive years no infected trees have been found there.

Prompt treatment of an infestation of black vine weevil in one Kentucky nursery in 1940 seems to have been successful, as careful

inspection during the growing season of 1941 failed to reveal any of the insects or signs of their feeding in the treated nursery. No shipments of plant materials from the white-fringed-beetle infested area of Florida, Louisiana, Mississippi, and Alabama were known to have entered Kentucky this year and careful examinations of plants shipped from the infested areas during the past few years have revealed no beetles. It is assumed that this beetle has not yet come into Kentucky.

One itinerant trucker was tried and convicted of violating the provisions of the Nursery Inspection Law.

Seed inspection. — The number of samples sent by dealers and individuals for testing was 5,300, as follows: legumes, 1,880; grasses, 1,227; tobacco, 1,117; cereals, 985; vegetables, 47; hemp, 39; and miscellaneous, 5. Besides these, 401 samples of various kinds, taken by our inspectors, were examined, making 5,701 in all. Tobacco seed cleaned amounted to 2,512½ pounds, in 1,117 lots. Much collaborative work with other laboratories was done and considerable research conducted on the testing of bluegrass seed.

The trend toward greater diversification in planting is quite evident. Dealers are stocking a greater variety as well as a better quality of seed than formerly.

Feed control. — During the year 1,322 samples of feed were analyzed and 279 determinations made for investigational work. Three suits filed for prosecution because of adulteration and misbranding resulted in verdicts for fine and cost. Several cancellations of registrations of feed brands of manufacturers living without the state also were made because of adulteration and misbranding. Many other irregularities were found in feeds this year arising from shortage of materials now used in war production or not now being imported.

The feed laboratory this year collaborated with some fifty other state and commercial chemists in work leading to development of new and more efficient methods for official analyses of feeds. It also undertook a joint project with the Department of Bacteriology on the microbiological determination of riboflavin in feeds.

Fertilizer control. — During the year, 935 samples were analyzed besides 689 determinations for investigational work. In five suits filed for violations of the fertilizer law the defendants appeared in court, pleaded guilty, and were sentenced to payment of fines and costs.

Several special projects were carried on during the year. One was on the effect different combinations of catalysts, together with variations of the time of digestion, has on the finding for nitrogen in or-

ganic materials used in fertilizers. About 500 nitrogen analyses were made in this study, and the information gained was useful in the regular nitrogen determinations made during the year. Different combinations of selenium, mercury, copper, and potassium sulfate were used and the time of digestion was varied. An investigation on the method for acid- and nonacid-forming-quality in fertilizers was continued. This consisted in work and study on two procedures for determining the calcium carbonate equivalent of the coarser than 20-mesh portion by evaluating the carbon dioxide evolved.

Creamery license.— Licenses to buy milk or cream on butterfat basis issued and in force totaled 1,338, of which 1,287 were renewals and 51 were issued to establishments beginning operation after July 1. The total included 8 creameries, 16 cheese plants, 7 condenseries, 69 milk plants and ice cream manufacturers, 39 independent operators of cream stations, and 1,199 cream stations under contract to creameries. Authority to test for the period ending June 30, 1942 was issued to 1,431 operators using the Babcock test. These included 1,142 renewal licenses, 180 licenses issued since July 1 after satisfactory examination, and 109 permits pending examination issued since July 1.

Examinations for applicants for license to test were held as follows: Bowling Green 5, Lexington 4, Louisville 5, Mayfield 3, Maysville 2, Owensboro 3, Princeton 2, Somerset 4, Walton 1, special 1. Of 657 applicants notified to appear for examination 348 appeared, 299 passed and 49 failed; of those failed, 16 reappeared and passed on the second examination.

During the year 646 inspections, including 17,362 tests, were made. Creamery operators were graded as follows: "A" and "B" (satisfactory), 251 operators; "C" (unsatisfactory), 197; "D" (probation), 103; "Continued D", 16; "E" (cited to appear before the Examining Board), 9; and "Incomplete", 70. "Satisfactory" inspection certificates were issued to operators grading A or B.

Of 27,186 milk and cream test bottles, cream test weights, and milk pipettes received for calibration, 435 were rejected. Items of testing equipment in use, found on inspection to be inaccurate and therefore the cause of inaccurate tests were: 48 cream test weights, 8 test scales, 24 thermometers, 5 centrifuges, 7 platform scales, 2 dividers, 11 platform scale weights, 33 pieces illegal glassware, and 20 miscellaneous pieces of equipment. These were condemned and ordered to be replaced.

The Examining Board decided 19 cases, as follows: 1 revoked

license was reinstated; 4 testers were continued on probation subject to future inspections; 2 were removed from probation on satisfactory inspections; 3 no longer testing were removed from the minutes, and 9 licenses were revoked because of unsatisfactory testing and violation of Rules and Regulations. There were 12 testers on probation by the Examining Board at the beginning of the year and 4 at the close.

Receipts for the year were \$12,215.24; and expenditures, \$7,367.33, as itemized:

Salaries	\$ 4,650.00
Labor	1,031.79
Communication service	172.70
Freight and express	21.53
Sundry and laboratory supplies	242.48
Travel	1,221.16
Miscellaneous	2.52
Furniture and fixtures	22.15
Total	\$ 7,367.33

WESTERN SUBSTATION

Crops.—Prolonged drouth in the summer of 1941 severely damaged all pastures, and the spring seedings of grasses and clovers, and reduced the hay yields and the size of peaches considerably below normal. The wheat crop was excellent, however; and fortunately showers came at the right time to bring the corn and tobacco crops thru in good condition, the crop of silage corn being more than enough to fill both silos. The first full crop of peaches since 1937 was harvested in August. This crop was practically free of insect injury, but the fruits were small because of the drouth. The apple crop was fair in yield but poor in quality.

Pasture fertilizer treatments.—Because of the severe drouth in the last half of the summer, the grazing season was terminated earlier than usual. During the 161 days which the steers were on the pastures those on the untreated field gained 45.4 pounds per acre, those on the field treated with rock phosphate gained 157.8 pounds, and those on the field treated with limestone and superphosphate gained 172.8 pounds. Carrying capacities of the fields were 2.3, 5.6, and 5.6 animals per acre, respectively. Floras on the fields were similar to those of recent years, tho Canada bluegrass perhaps furnished relatively somewhat more of the grazing on Field 3 than previously.

Fruit varieties.—The variety-testing phase of the horticulture work was greatly enlarged in the spring of 1939, when varieties of pecans, walnuts, apples, peaches, plums, strawberries, dewberries,

blackberries, raspberries, and grapes were planted at the Western Kentucky Substation. In 1941 all these new plantings bore crops except the apples, pecans, and walnuts, these being slow to come into production. The Field Day visitors on July 31 were deeply impressed with the Brainerd blackberry, a new heavy-producing late variety which was in full production at that time; several of the grape varieties that were ripe; and a number of the peach varieties that gave some promise of cold resistance. Because of frequent losses of peach crops from cold weather in western Kentucky, cold-resistant peach varieties are urgently needed.

Control of soil erosion on steep land. — In 1928 a project was established to determine the effectiveness of terraces and “staked in” brush dams in controlling erosion on untreated land and on land treated with limestone and fertilizers. A 6-year rotation consisting of grass and legumes 4 years and corn 2 years was used. From this project the following conclusions can be drawn:

1. A slope of $12\frac{1}{2}$ percent is too steep to cultivate satisfactorily in a 6-year rotation without a great loss of soil and plant food, even tho terraces and dams are used and the soil is treated with fertilizer.

2. While building up the fertility of the land so that it will raise a good vegetative covering, mechanical methods of controlling erosion (such as terraces and dams) are necessary on such slopes.

3. Terracing is very effective in preventing erosion at a maintenance cost approximately one-half as much as that for “staked-in” brush dams.

Curing dark fired tobacco. — Search for a method of curing dark fired tobacco that would save part of the fuel usually used in curing was not particularly promising this year. In one section of the curing barn the “modified” old method of curing was used in which an attempt is made to control the temperature but not the humidity. Wood and sawdust are used as fuels, but no water is added to the sawdust. In another section of the barn the tobacco was air-cured without fires and then finished with smoke made by burning sawdust. In the fire-curing section 510 sticks of 7 plants each were housed, with sticks spaced 9 inches apart; while in the air-curing section only 420 sticks of 6 plants each, spaced 12 inches on the rack, were housed. In curing the fire-cured tobacco, the fires were burned 26 days, using 1.25 cords of wood and 160.4 cubic feet of sawdust. To finish the air-cured tobacco with smoke, the fires were burned 26 days, using .54 cord of wood and 167.4 cubic feet of sawdust.

When the tobacco was taken down and placed in bulk, the fire-

cured tobacco was a good quality snuff tobacco, of a uniform dark color, showing a better finish than the air-cured tobacco finished with smoke. The air-cured tobacco was a medium quality snuff tobacco having a dark color on the inside of leaf, and some green spots on the trash leaves.

Meetings held.—The facilities of the Substation were used during the year for a number of meetings, including the following: Farmers' short course, 4-H club leaders' conference, junior 4-H club camp, Guernsey Breeders Association, apple-marketing meeting, county delegations, field day, and meetings of county agricultural and home agents and homemakers.

ROBINSON SUBSTATION

General farming.—Crops of corn and hay were not so good this year as last because of drouth and wind storms. The field corn averaged 57 bushels per acre as against 60 bushels last year, and the hay crop was only 45 tons as against 60 tons last year. The apple crop, however, amounting to some 500 bushels of good fruit that sold at 50 cents to \$1.00 a bushel, was heavier than a year ago. Both the strawberry and the cherry crops were very light, and sold at 40 cents a gallon. There is demand on the local market for any and all fruits offered for sale.

Experimental work was continued with dairy cattle, hogs, chickens, and turkeys.

Adapted varieties of corn.—For the second year, hybrid corns were grown, along with four varieties of open-pollinated corn as checks, to determine the best kinds for this part of the state. Dry weights for the two years were as follows:

<i>Hybrids</i>	<i>Bushels per acre</i>	
	<i>1940</i>	<i>1941</i>
Ky. 102	79.1	69.2
Ky. 72-B	80.0	66.5
Ky. 103	76.5	69.6
Ky. 69-B	80.6	63.0
Ky. 72	77.7	63.5
U. S. 13	73.5	63.5
Ky. 201-J	75.3	61.7
Ky. 78-B	69.5	63.9
Ky. 69	70.0	62.2
Average	76.4	64.8
<i>Open-pollinated varieties</i>		
Reid's Yellow Dent	59.5	65.1
Midland Dent	60.0	66.3
Boone County	64.3	58.1
Johnson County	59.8	57.7
Average	60.9	61.8

Assistance to farmers.—Purebred seed corn was exchanged, bushel for bushel, for feed corn. Free service to the Duroc and Hampshire boars was given. Jersey bull calves, young hogs, and purebred cockerels were furnished at reasonable prices and instruction in general farming and raising livestock was given.

Forestry.—There were no fires of consequence on the timber tract in the fall of 1941. The road up Cole's fork was put in good condition with NYA labor from the camp on Clemon's fork. Work on the NYA camp progressed thru the year, three buildings being put under temporary roof.

Meetings.—The following were held: leaders' conferences for county and home demonstration agents and 4-H club leaders; home-makers camp; 4-H club camp; field day; annual day for women of Breathitt county; Robinson 4-H festival, and play day for boys and girls.

NEW PROJECTS

The Intermediary Metabolism of Old Age.

The Thiamin, Riboflavin and Nicotinic Acid Content of Fresh and Canned Pork, Loin and Spareribs, and of Fresh and Cured Ham, all cooked various ways.

A Study of Some Factors that Help to Preserve Tissue Structure of Foods.

A Genetic History of the Breeds of Light Horses.

The Effect of Minor Elements on Certain Crops Grown under Field Conditions.

The Reliability and Practicability of Rapid Field Tests on Certain Conducting Tissues as Guides for Soil Treatment.

Investigations of Relationship between the yield and the Amount of Soluble Nitrogen in the Stems of Potatoes at Various Stages of Growth.

The Detection and Measurement of Ovulation Potentials in Farm Animals.

A Comparison of an Open-Pollinated Corn with two Popular Hybrids for Hogs.

PUBLICATIONS

BULLETINS
NUMBERS

411. Index numbers of prices and production of farm products in Kentucky. Dana G. Card, A. J. Brown, and O. M. Farrington. January, 1941.
412. Resistance of strains of red clover to pea-aphid injury. H. H. Jewett. April, 1941.
413. Greenhouse tests of the availability of phosphorus in certain phosphate fertilizers. P. E. Karraker, Harold F. Miller, C. E. Bortner, and Jack R. Todd. June, 1941.
414. Classification of *Corynebacterium equi*. D. W. Bruner and P. R. Edwards. June, 1941.
415. Effect of tobacco mosaic on yield and quality of dark fire-cured tobacco. E. M. Johnson and W. D. Valleau. June, 1941.
416. Effect of formaldehyde fumigation on mortality of chick embryos. W. M. Insko, Jr., Dewey G. Steele, and Cecil M. Hinton. June, 1941.
417. Community land-use planning committees: organization, leadership, and attitudes, Garrard County, Kentucky, 1939. Howard W. Beers, Robin M. Williams, John S. Page, and Douglas Ensminger. June, 1941.
418. Legal aspects of farm tenancy in Kentucky. W. A. Hockley and W. D. Nicholls. June, 1941.
419. Systems of farming for the central bluegrass region. W. D. Nicholls, George B. Byers, and John H. Bondurant. June, 1941.

ANNUAL REPORT

53rd Annual Report of the station

Part I: Report of the Director for 1940. Thomas P. Cooper.

Part II: Bulletins 398-410: Circular 51

REGULATORY SERIES BULLETINS

26. Commercial fertilizers in Kentucky in 1940. J. D. Turner, H. R. Allen, and Lelah Gault. June, 1941.
27. Commercial feeds in Kentucky in 1940. J. D. Turner, Stacy B. Randle, W. G. Terrell, and J. J. Rose. August, 1941.
28. Seed inspection in Kentucky, 1940-41. W. A. Price, Mary Didlake, E. C. Vaughn, Encil Deen, Howard Tilson, Alice McDaniel, Katharine Fried, Margaret Morton, Mary Lee Littrell, and Lucy Baugh. September, 1941.
29. Inspection, certification, and transportation of nursery stock in Kentucky with a brief report for the year ended June 30, 1941. W. A. Price and Howard G. Tilson. September, 1941.

SCIENTIFIC PAPERS

In Agronomy

- The amount of available nitrogen under burley tobacco and its effect on yield and quality of the crop. P. E. Karraker and C. E. Bortner. Assoc. South. Agr. Workers Proc. 42nd Ann. Convention, 1941, pp 98-99.
- The binomial system of nomenclature for plant viruses. W. D. Valleau. Chron. Bot. 6:223, Feb. 10, 1941.
- Breeding tobacco for resistance to mosaic. W. D. Valleau. Presented at meeting of Ky. Branch of Soc. of Amer. Bact., Oct. 31, 1941.
- A comparison of various extracting solutions for measuring the availability of phosphorus in soils of known fertilizer treatment and crop performance. M. E. Weeks and P. E. Karraker. Soil Sci. 51:41-54, Jan., 1941.
- Conidial production in culture by *Cercospora nicotianae*. Stephen Diachun and W. D. Valleau. Phytopathology 31:97-98, Jan., 1941.
- Development of machinery for harvesting bluegrass seed. J. B. Kelley. Agr. Eng. 22:353-354, Oct., 1941.
- Experimental production of symptoms in so-called recovered ring-spot tobacco plants and its bearing on acquired immunity. W. D. Valleau. Phytopathology 31:522-533, June, 1941.

- Extension problems in a farm-reservoir project. John L. McKittrick. Presented at meeting of Amer. Soc. Agr. Engin., June 23, 1941.
- Isolation of *Bacterium angulatum* from overwintered tobacco-field soil. Stephen Diachun, W. D. Valleau, and E. M. Johnson. Presented at meeting of Amer. Phytopath. Soc., Dec. 28, 1941.
- Isolation of leaf spot bacteria from soil. Stephen Diachun, W. D. Valleau, and E. M. Johnson. Presented before Ky. branch Soc. Amer. Bacteriologists, Oct. 31, 1941.
- The Kentucky farm buildings extension program for rural carpenters. Jesse B. Brooks. Presented at meeting of Farm Structures Division of Amer. Soc. Agr. Engin., June 23, 1941.
- Observations on grass diseases in Kentucky and their relation to grass improvement. Lawrence Henson, J. T. Spencer, and T. Hayden Rogers. Asso. South. Agr. Workers Proc., 1941, pp 50-51.
- Powdery mildew of potato in Kentucky. W. D. Valleau. Phytopathology 31:357-358, April, 1941.
- Soil sterilizer for small greenhouse. Lester S. O'Bannon. Heating, Piping and Air Conditioning 13:361-363, June, 1941.
- Specific objectives in grass breeding programs. J. T. Spencer. Presented at Southern Pasture and Forage Crop Conference, July 21, 1941.
- Stomatal behavior in field tobacco. Stephen Diachun. Ky. Acad. Sci., Trans. 9:20-23, 1941.
- Virus distribution in leaves of mosaic-susceptible tobacco plants inoculated at topping time. W. D. Valleau and Stephen Diachun. Jour. Agr. Res. 62:249-254, Feb., 1941.
- Virus distribution in mosaic-resistant tobacco and its relation to pattern development in susceptible varieties. W. D. Valleau and Stephen Diachun. Jour. Agr. Res. 62:241-247, Feb., 1941.
- What the engineer should know about the production of white burley tobacco. Lester S. O'Bannon. Presented at meeting Amer. Soc. Mech. Engin., Oct. 12-15, 1941.
- In Animal Husbandry and Dairying*
- Calculating pasture yields with dairy heifers as experimental animals. H. B. Morrison and Fordyce Ely. Presented before Amer. Dairy Sci. Assoc. Abstract in Jour. Dairy Sci. 24:515, June, 1941.
- Composition and quality of feed consumed by laying hens versus composition and quality of body fat and eggs produced. G. Davis Buckner, W. M. Insko, Jr., and Amanda Harms. Poultry Sci. 20:121, March, 1941.
- Distribution of *Pseudomonas fragi*. H. B. Morrison and B. W. Hammer. Jour. Dairy Sci. 24:9-18, Jan., 1941.
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- Relative weights of boiled and unboiled eggs and their yolks before and after drying. G. Davis Buckner, W. M. Insko, Jr., and Amanda Harms. Presented at annual meeting Ky. Acad. Sci., April 25, 1941.
- A study of some of the changes in composition of egg yolk fat during incubation. G. Davis Buckner, W. M. Insko, Jr., and Amanda Harms. Presented at annual meeting Ky. Acad. Sci., April 25, 1941.
- Using livestock to measure results of pasture experiments. W. P. Garrigus. Assoc. South. Agr. Workers Proc., 1941, pp 36-37.
- In Animal Pathology*
- Abscesses affecting the central nervous system of sheep. F. E. Hull and E. L. Taylor. Amer. Jour. of Vet. Res. 2:356-357, July, 1941.
- The beta phases of the genus *Salmonella* with special reference to two undescribed *Salmonella* types. P. R. Edwards and D. W. Bruner. Jour. Infect. Dis. 69:220-223. Nov.-Dec., 1941.
- The demonstration of nonspecific components in *Salmonella paratyphi A* by induced variation. D. W. Bruner and P. R. Edwards. Jour. Bact. 42:467-478, Oct., 1941.

- Examination of the eyes of horses and mules. B. J. Errington and Capt. Wayne Shipley. Amer. Vet. Med. Assoc. Jour. 35:96-105, April, 1941.
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- Horse and mule production. W. W. Dimock. Amer. Vet. Med. Assoc. Jour. 98: 369-380, May, 1941.
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- Shigella equirulis* infection in a sow. P. R. Edwards and E. L. Taylor. Cornell Vet. 31:392-393, Oct., 1941.
- The stability of VI antigen of *Salmonella typhi*. C. A. Peluffo. Soc. Expt. Biol. and Med. Proc. 48: 340-343, Oct., 1941.
- Two new *Salmonella* types closely related to *Salmonella muenchen*. P. R. Edwards and D. W. Bruner. Amer. Jour. Hyg. 34:121-124, Nov., 1941.
- In Chemistry*
- The amount of boron absorbed by soybean plants and its effect on their growth. W. S. Hodgkiss, R. H. Hageman, and J. S. McHargue. Presented at annual meeting of Amer. Assoc. Adv. Sci., Dec., 1941.
- Comparison of perchloric acid distillation and sodium carbonate fusion for determination of total boron in soil. J. S. McHargue and W. S. Hodgkiss. Assoc. Off. Agr. Chem. Jour. 24:250-252, May, 1941.
- A cutter for spectroscopic electrodes. E. S. Hodge. Accepted for publication in Indus. and Engin. Chem., Analyt. Ed.
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- The effect of potassium iodide on the ascorbic acid content and growth of tomato plants. R. H. Hageman, E. S. Hodge, and J. S. McHargue. Presented at annual meeting Amer. Assoc. Adv. Sci., Dec. 26-31, 1941.
- Methods for the determination of boron in soils. W. S. Hodgkiss and J. S. McHargue. Presented at annual meeting Assoc. Off. Agr. Chem., Oct., 1941.
- Methods for the determination of moisture in tobacco. C. W. Woodmansee, Karl E. Rapp, and J. S. McHargue, Associate Referee. Presented at meeting Assoc. Off. Agr. Chem., Oct., 1941.
- A modification of the official method for the determination of nicotine in tobacco. Karl E. Rapp, C. W. Woodmansee, and J. S. McHargue. Accepted for publication in Assoc. Off. Agr. Chem. Jour.
- The necessity of minor as well as major chemical compounds in a fertilizer for a depleted sandy loam soil. J. S. McHargue, R. H. Hageman, W. S. Hodgkiss, and E. S. Hodge. Presented before the Div. Agr. and Food Chem., Amer. Chem. Soc., April, 1941.
- The precision of the colorimetric determination of boron in plant materials by the quinalizarin procedure. W. S. Hodgkiss, J. S. McHargue, and E. B. Offutt. Accepted for publication in Assoc. Off. Agr. Chem. Jour.
- Report on less common elements in plant material. R. H. Hageman, J. S. McHargue, and W. S. Hodgkiss. Presented at meeting Assoc. Off. Agr. Chem., Oct., 1941.
- Report on less common metals. E. S. Hodge and J. S. McHargue, Associate Referee. Presented at annual meeting Assoc. Off. Agr. Chem., Oct., 1941.
- Report on less common metals in soils. W. S. Hodgkiss and J. S. McHargue, Associate Referee. Presented at annual meeting of the Assoc. Off. Agr. Chem., Oct., 1941.

Report on methods for the determination of copper and zinc in soils. G. D. Sherman and J. S. McHargue, Associate Referee. Presented at annual meeting Assoc. Off. Agr. Chem., Oct., 1941.

Report on methods for the determination of boron in forage crops, vegetables, fruits, and nuts. J. S. McHargue, Associate Referee, and W. S. Hodgkiss. Assoc. Off. Agr. Chem. Jour. 24:518-520, Aug., 1941.

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Spectrography in agricultural research. E. S. Hodge and J. S. McHargue. Presented at annual meeting Assoc. Off. Agr. Chem., Oct., 1941.

In Entomology and Botany

Methyl bromide fumigation for destruction of the strawberry crown borer. P. O. Ritcher. Jour. Econ. Ent. 34:67-72, April, 1941.

In Feed and Fertilizer Control

Report on acid- and base-forming quality of fertilizers. H. R. Allen, Associate Referee, and Lelah Gault. Assoc. Off. Agr. Chem. Jour. 24:293-298, May, 1941.

Report on acid hydrolysis for fats in dog feeds. Stacy B. Randle. Presented at meeting Assoc. Off. Agr. Chem., Oct., 1941.

In Horticulture

A rapid method for estimating carbon contained in plant extracts. E. M. Emmert and C. S. Waltman. Presented at meeting of Amer. Soc. Hort. Sci., Dec., 1941.

The response of peaches in Kentucky to cultivation and cover crops and to sod cultures. A. J. Olney and W. D. Armstrong. Presented at meeting of Amer. Soc. Hort. Sci., Dec., 1941.

Strawberry plant behavior as influenced by mulch. W. D. Armstrong. Presented at meeting of Amer. Soc. Hort. Sci., Dec., 1941.

FINANCIAL STATEMENT

Kentucky Agricultural Experiment Station in Account with the United States Appropriations, 1941					
	Hatch	Adams	Purnell	Bankhead-Jones	Bankhead-Jones offset
<i>Receipts</i>					
From the Treasurer of the United States as per appropriations for fiscal year ending June 30, 1941	\$15,000.00	\$15,000.00	\$60,000.00	\$78,938.04	
Receipts from sources within the state as Bankhead-Jones offset					\$78,938.04
Total	15,000.00	15,000.00	60,000.00	78,938.04	78,938.04
<i>Expenditures</i>					
Personal services	14,271.12	14,731.09	48,359.33	68,802.39	75,280.66
Supplies and materials	50.93	262.59	1,057.34	4,305.90	1,216.12
Communication service	101.95		184.81	191.01	14.00
Travel expenses	146.50		4,639.04	956.09	376.57
Transportation of things	1.50	5.49	1.92	49.73	6.57
Printing and illustrating publications	428.00		3,374.20	1,115.85	
Heat, light, water, power, fuel				39.50	248.66
Contingent expenses			42.00		
Equipment		.83	2,341.36	3,005.42	1,523.71
Structures and nonstructural improvements				472.15	271.75
Total	\$15,000.00	\$15,000.00	\$60,000.00	\$78,938.04	\$78,938.04